

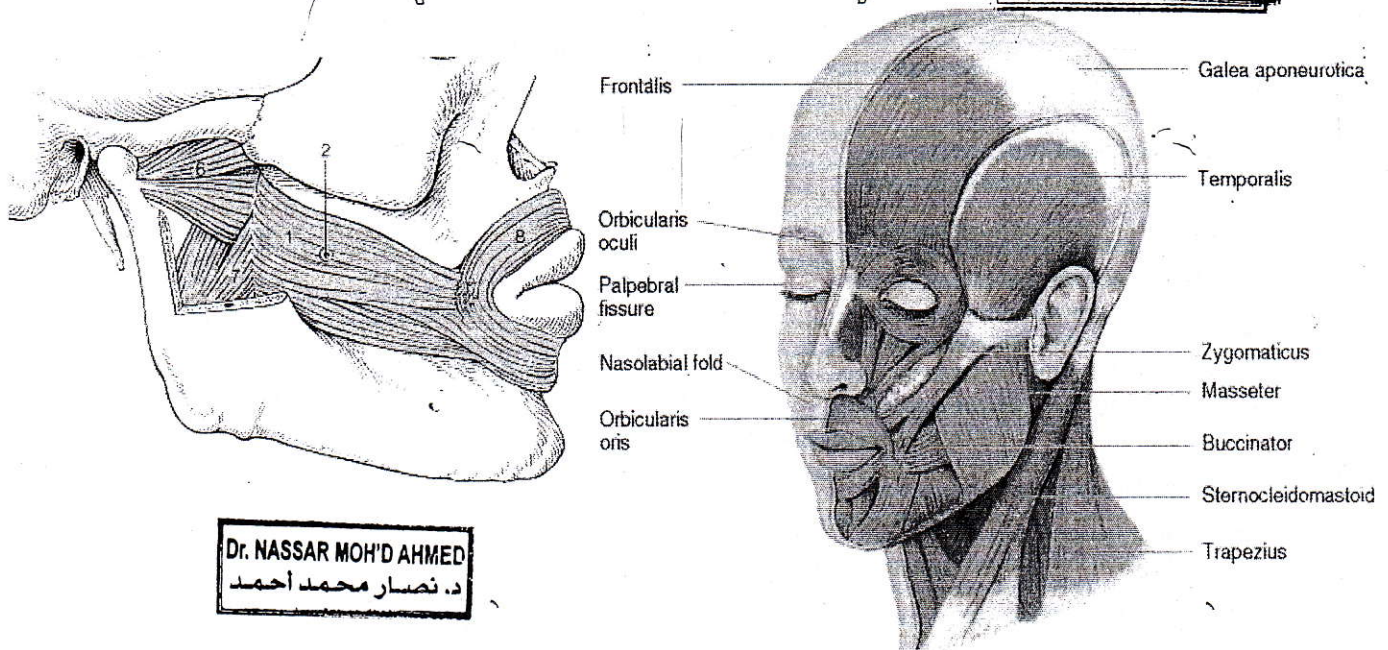
UNIVERSITY OF ADEN. FACULTY OF MEDICINE AND HEALTH SCIENCES
DEPARTMENT OF MORPHOLOGICAL SCIENCES
HUMAN ANATOMY I FOR MEDICAL STUDENTS

GENERAL MYOLOGY

MUSCLES OF HEAD & NECK

(Lectures 9 & 10)

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MYOLOGY is the branch or part of the Anatomy which studies the muscles belonging to the Locomotor Apparatus: the skeletal muscles.

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The generalities about this theme are known as General Myology while the study of the muscles by regions is called Special Myology. There are more than 650 individual muscles in our body that make up about 40 % of the total body weight.

At beginning you should know that **each muscle is an organ**. Why? Because it is formed by several types of tissues and one of them (the striated muscular tissue) is predominant and determines the function due its particular property: the **contractibility**, which is defined as the capacity of the muscle fiber (muscular cell) to undergo shortening thus, producing a movement. Besides this, each muscle shows a peculiar external shape, performs specific action(s) and we can distinguish two main anatomical portions in it: a **belly** (fleshy, contractile part) and a **fibrous part** or **attachment-structure** (inelastic, non-contractile part).

Let deep into this idea. A muscle is composed of bundles of specialized cells capable of contraction and relaxation to create movement. As you should know, there are three types of muscle in the body: skeletal, smooth, and cardiac. But only the striated muscle is able to move the bones: that is the reason of the name "skeletal muscles". If one were to slice through a muscle diagonally, he would find that it resembles a telephone cable. Inside is a bundle of smaller cables, and each bundle surrounds still smaller ones. The first and largest bundle is made up of muscle fibers in which there are nerves, blood vessels, and connective tissue. Each fiber is built up from smaller strands called myofibrils, and each myofibril contains interlaced filaments of muscle proteins. Nerve impulses bring about muscle contraction and contraction causes fiber shortening so light and dark fibers become closer together. As contraction of muscle ends, fibers relax and muscle length is once again attained due to increased length of muscle fiber.

Of course, we can find striated muscular fibers in other part of our body not in relation with the bones, e.g.: forming sphincters, in the tongue, at beginning of the respiratory and digestive tracts, etc. On the other hand, the smooth, involuntary muscles is the blood vessels walls, stomach, digestive tract, and other internal organs; and the cardiac muscles, which are a cross between the smooth and the striped muscles, is only in the heart. Both cardiac and smooth muscles are called involuntary muscles, because they cannot be consciously controlled.

ATTACHMENTS

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ATTACHMENTS

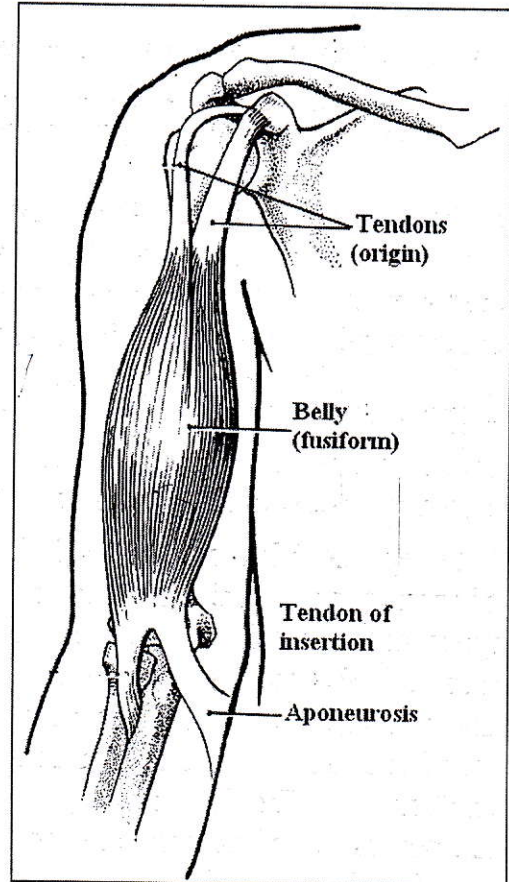
The muscles are connected with the bones, cartilages, ligaments, and skin, either **directly**, or through the intervention of **fibrous structures** called **tendons**, **aponeurosis** or **raphe**. Where a muscle is attached to bone or cartilage, the fibers end in blunt extremities upon the **periosteum** or **perichondrium**, and **do not** come into direct relation with the osseous or cartilaginous tissue. Where muscles are connected with its skin, they lie as a flattened layer beneath it, and are connected with its **areolar tissue** by larger or smaller bundles of fibers, as in the muscles of the face.

Tendons are white, glistening, fibrous cords, varying in length and thickness, sometimes round, sometimes flattened, and devoid of elasticity. They consist almost entirely of white fibrous tissue, the fibrils of which have an undulating course parallel with each other and are firmly united together. When boiled in water tendon is almost completely converted into gelatin, the white fibers being composed of the albuminoid collagen, which is often regarded as the anhydride of gelatin. They are very sparingly supplied with blood vessels, the smaller tendons presenting in their interior no trace of them. Nerves supplying tendons have special modifications of their terminal fibers, named **organs of Golgi**.

Aponeuroses are flattened or ribbon-shaped tendons, of a pearly white color, iridescent, glistening, and similar in structure to the tendons. They are only sparingly supplied with blood vessels.

Raphe: the fibers cross at the midline with those of the opposite side.

In the description of a muscle, the term **origin** is meant to imply its more fixed or central attachment; and the term **insertion** the movable point on which the force of the muscle is applied; but the origin is absolutely fixed in only a small number of muscles, such as those of the face which are attached by one extremity to immovable



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bones, and by the other to the movable integument; in the greater number, the muscle can be made to act from either extremity.

In the dissection of the muscles, attention should be directed to the exact *origin*, *insertion*, and *actions* of each, and to its more important *relations* with surrounding parts. The action of the muscle deduced from its attachments, or even by pulling on it in the dead subject, is not necessarily its action in the living.

IMPORTANT!: *The muscular attachment that remains steady during contraction is called **origin**. The muscular attachment that moves towards the origin during contraction is called **insertion**. Usually the origin is placed proximal to the insertion. However both term origin and insertion are at times interchangeable*

SHAPE OR FORM

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The muscles vary extremely in their form. In the limbs, they are of considerable length, especially the more superficial ones; they surround the bones, and constitute an important protection to the various joints. In the trunk, they are broad, flattened, and expanded, and assist in forming the walls of the trunk cavities. Hence the reason of the terms, **long, broad, short**, etc., used in the description of a muscle.

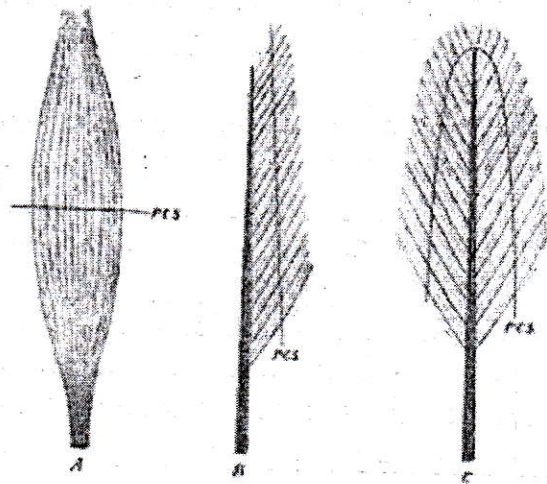
ARRANGEMENT OF THE FIBERS (FASCICULAR ARCHITECTURE OF THE MUSCLES)

There is considerable variation in the arrangement of the fibers of certain muscles with reference to the tendons to which they are attached.

Firstly, in some muscles the fibers are **parallel and run directly from their origin to their insertion**; these are quadrilateral muscles, such as the *thyrohyoid*. A modification of these is found in the **fusiform** muscles (A), in which the fibers are **not quite parallel**, but slightly curved, so that the muscle tapers at either end; in their actions, however, they resemble the quadrilateral muscles.

Secondly, in other muscles the fibers are **convergent**; arising by a broad origin, they converge to a narrow or pointed insertion. This arrangement of fibers is found in the triangular muscles—e. g., the *temporal*. In some muscles, which otherwise would belong to the quadrilateral or triangular type, the origin and insertion are not in the same plane, but the plane of the line of origin intersects that of the line of insertion; such is the case in the *pectineus*.

Thirdly, in some muscles (e. g., *flexor pollicis longus* & the *peronei*) the fibers are **oblique and converge, like the plumes of a quill pen**, to one side of a tendon which runs the entire length of the muscle; such muscles are termed **unipennate (B)**. A modification of this condition is found where oblique fibers converge to both sides of a central tendon; these are called **bipennate (C)**, and an example is the *rectus femoris*. *Deltoid* is considered as **multipennate**.



Finally, there are muscles in which the fibers are arranged in curved bundles in one or more planes, as in the *sphincters* and *orbicular* muscles.

The arrangement of the fibers is of considerable importance in respect to the relative **strength and range of movement of the muscle**. Those muscles where the fibers are long and few in number have great range but diminished strength; where on the other hand the fibers are short and more numerous there is great power but lessened range.

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NOMENCLATURE or TERMINOLOGY of the skeletal muscles

The names applied to the various muscles have been derived:

1. from their situation, as the tibial, radial, ulnar, etc.
2. from their direction, as the rectus abdominals, oblique, transversalis, etc.
3. from their uses, as flexors, extensors, abductors, etc.;
4. from their shape, as the deltoid, rhomboid, etc.
5. from the number of their divisions, as the biceps and triceps attending to the number of heads and digastric attending to the number of bellies.
6. from their points of attachment, as the sternocleidomastoid, sternohyoid, etc.
7. and also according to contrasting features:

Pectoral major --- Pectoral minor
Adductor longus --- Adductor brevis

MUSCULAR ACTION

It is impossible for an individual to throw into action any one muscle; in other words, movements, not muscles, are represented in the central nervous system. Each movement at a joint is the result of the coordinated activity of different muscles or groups of muscles. These muscle groups are named and classified according to their function in a particular movement into 3 groups:

- I. AGONISTS (Prime movers): they bring about the desired movement. They are the principal, chief moving force or leader of the movement.
- II. SYNERGISTS: they assist the prime movers in bringing about the desired movement. Also, they prevent or inhibit the not required movement. **Fixator** muscles belong to this group, as they provide stable or fixed base (stabilized, steady joint) for the proper action of the prime movers.
- III. ANTAGONISTS (misnamed "opponents"): they cooperate with the prime movers by gradual, actively controlled relaxation, which guarantee the desired movement to be performed smoothly and precisely.

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It should be noticed that the same muscle may act as prime mover, synergist, fixator or antagonist under different circumstances.

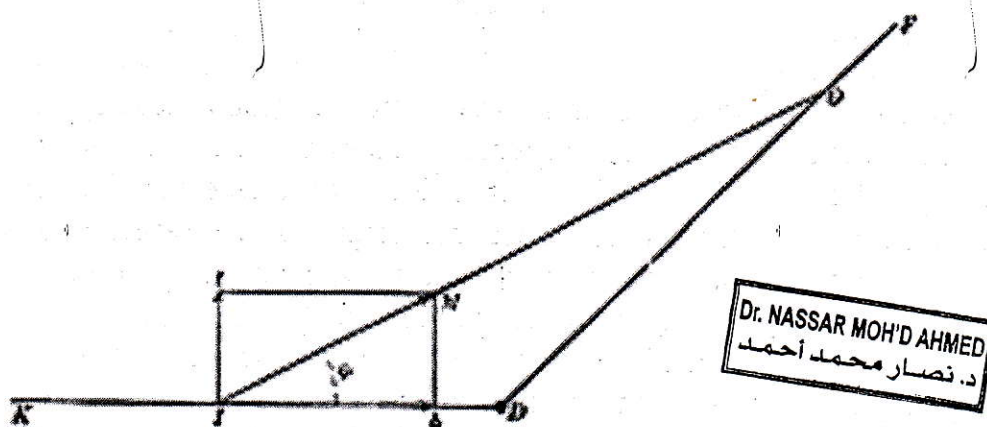
In studying the mechanical action of muscles (muscular biomechanical) the individual muscle **cannot always** be treated as a single unit, since different parts of the same muscle may have entirely different actions. Most muscles are, however, in a mechanical sense units. But in either case the muscle fibers constitute the elementary motor elements.

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In order to reckon the amount of work which a muscle can perform under the most favorable conditions it is necessary to know

- Its **physiological cross-section**: the force (strength, power) of the muscular contraction is directly proportional to the **number and size** of the muscle fibers.
- The **maximum shortening**: the **range** (amplitude) of the movement is directly proportional to the length of the muscle fibers.
- The **position of the joint** when the latter is obtained: the **direction** of the fibers in relation to the line of **pull modifies the quality** of the muscular contraction and thus, the resulting movement.

If we consider now the action of a single muscle extending over a single joint in which one bone is fixed and the other movable, we will find that muscle pull can be resolved into two components, a turning component and a friction or pressure component as shown in the following figure:



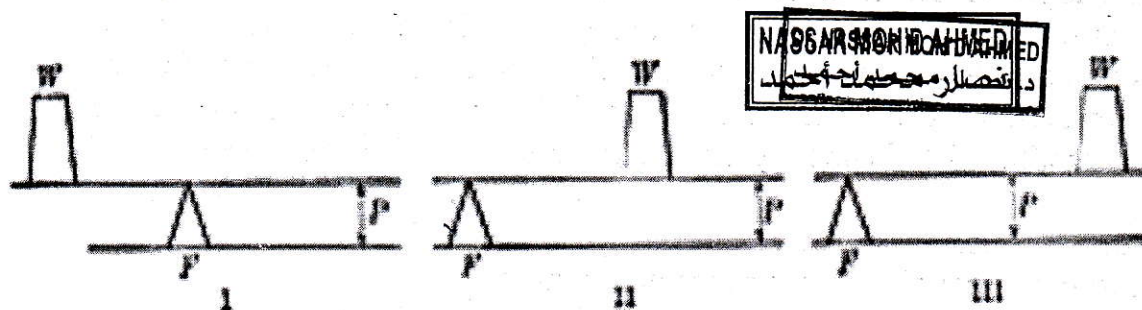
DF = the fixed bone from which the muscle takes its origin.

DK = the movable bone.

OI = a line from the middle of origin to the middle of insertion.

IM = size and direction of the muscle pull.

The majority of the muscles of the body act on bones as the power on levers. Levers of the III class are the most common, as the action of the Biceps, and the Brachialis muscles on the forearm bones. Levers of the I Class are found in movements of the head where the occipito-atlantal joint acts as the fulcrum and the muscles on the back of the neck as the power. There are no levers of the II Class represented in the body.



Clinical points:

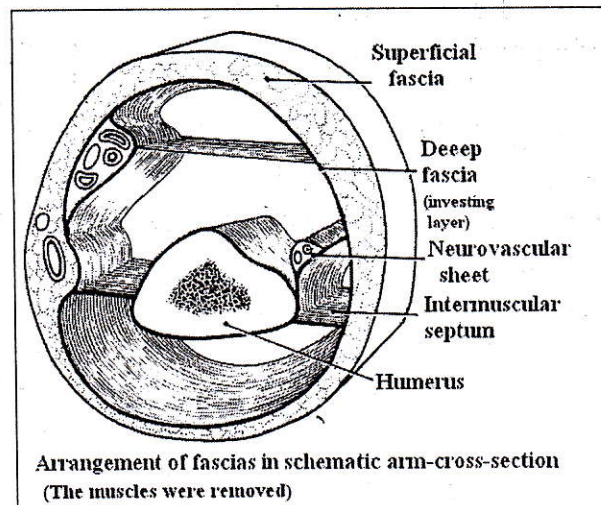
- By a consideration of the action of the muscles, the surgeon is able to explain the causes of displacement in various forms of fracture, and the causes which produce distortion in various deformities, and, consequently, to adopt appropriate treatment in each case.
- The relations, also, of some of the muscles, especially those in immediate apposition with the larger blood vessels, and the surface markings they produce, should be remembered, as they form useful guides in the application of ligatures to those vessels.

- During resting condition (absence of active contraction), energy muscles perform a partial state of contraction called **muscle tone**. It allows in keeping posture, maintaining position of the viscera, opposing falling down of body parts by the action of gravity and usual closure of natural orifices.
- The active exercise (workout) improves the size and activity of the muscles –controlled hypertrophy- and disuse cause wasting of the muscle- disuse atrophy.

ACCESSORY STRUCTURES (apparatus) OF MUSCLES

- The **fasciæ** are fibro-areolar or aponeurotic laminæ, of variable thickness and strength, found in all regions of the body, investing the softer and more delicate organs. They have been subdivided, from the situations in which they occur, into superficial and deep.

1. The **superficial fascia** is found immediately beneath the integument over almost the entire surface of the body. It connects the skin with the deep fascia, and consists of fibro-areolar tissue, containing in its meshes pellicles of fat in varying quantity. Fibro-areolar tissue is composed of **white fibers** and **yellow elastic fibers** intercrossing in all directions, and united together by a homogeneous cement or ground substance, the **matrix**.

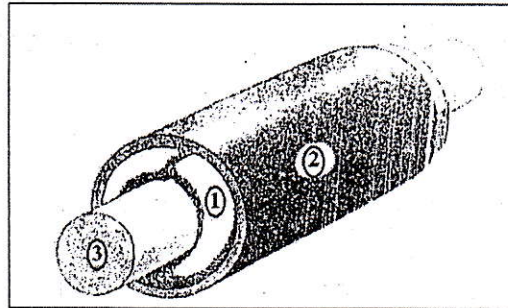


2. The **deep fascia** is a dense, inelastic, fibrous membrane, forming sheaths for the muscles, and in some cases affording them broad surfaces for attachment. It forms a strong investment which not only binds down collectively the muscles in each region, but gives a separate sheath to each, as well as to the vessels and nerves. The fasciæ are thick in unprotected situations, as on the lateral side of a limb, and thinner on the medial side. The deep fasciæ assist the muscles in their actions, by the degree of tension and pressure they make upon their surfaces; the degree of tension and pressure is regulated by the associated muscles, as, for instance, by the Tensor fasciæ

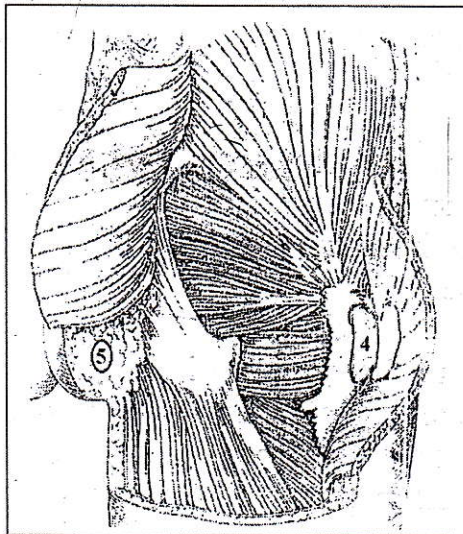
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latæ and Glutæus maximus in the thigh, by the Biceps in the upper and lower extremities, and Palmaris longus in the hand. In the limbs, the fasciæ not only invest the entire limb, but give off septa which separate the various muscles, and are attached to the periosteum: these prolongations of fasciæ are usually spoken of as **inter-muscular septa**. (→ See previous picture)

- **Tendon sheath:** double layer of synovial membrane (1) with an outer fibrous layer (2) that surround the tendon (3) and act as a gliding mechanism during muscular contraction.

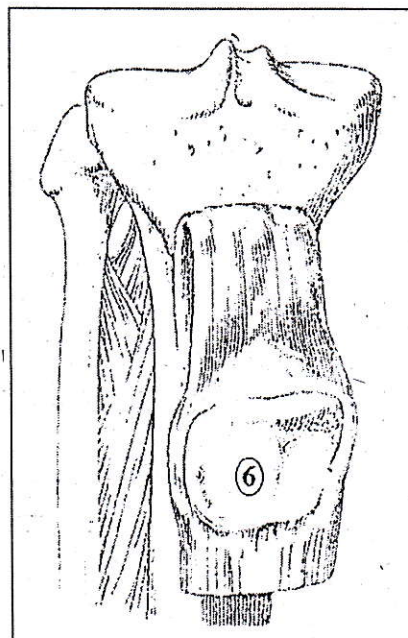


- **Synovial bursa (4):** extensions of the synovial membrane of joints which are interposed between the muscle and the bone to reduce friction during movement.
- **Fatty bodies (5):** 'Fat pads' or 'corporal adiposa'. Pads of fat lying between adjacent muscles with similar action than synovial bursa



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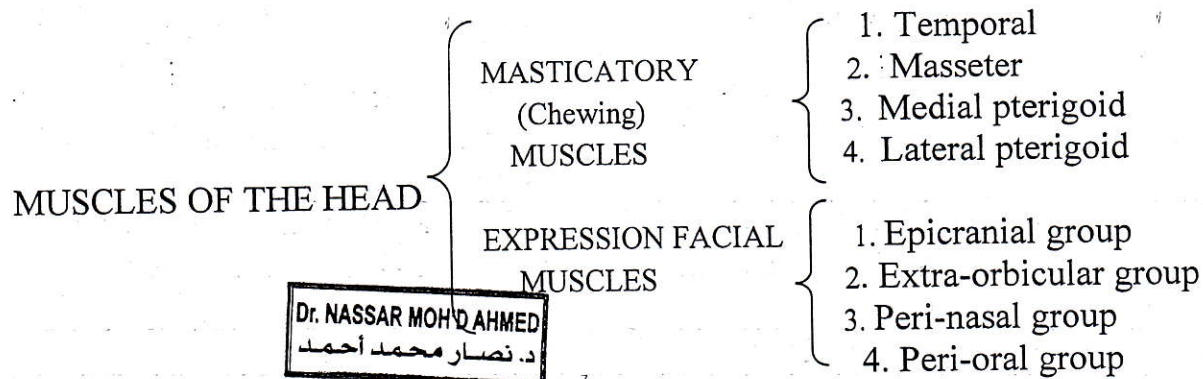
- **Sesamoid bones (6):** short bones ossified within a tendon which takes part of the structure and function of some joints. E.g. patella at the knee joint limiting extension, sesamoid bones at the first metatarsophalangeal joint act as support of arches of foot.



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SPECIAL MIOLOGY: MUSCLES OF THE HEAD

To study the skeletal muscles of the head and neck we should consider the following division:



(→ Other striated muscles in relation with the movements of the eyeball, inside middle ear, forming the tongue and the soft palate and the pharynx and the larynx walls will be described in the respectively systems of organs: sense organs, digestive system and respiratory system.)

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GENERAL CHARACTERISTICS OF THE TWO MAIN SKELETAL GROUPS OF MUSCLES OF THE HEAD

The expression facial muscles show some peculiarities which distinguish them from the masticatory muscles and from other groups of skeletal muscles. Let's summarize them in the following table:

	MASTICATORY	EXPRESSION-FACIAL
• Attachments	Both ends have bony attachments and the insertion is always on the mandible.	At least in one end the attachment is cutaneous although in most cases in both ends.
• External features	They are larger and stronger (powerful)	They are smaller and weaker (for movement of precision)
• Presence of fascia	Each of them has its proper fascia.	They have not fascia except one (buccinator).
• Situation and Disposition	Occupying the temporal & infratemporal fossae and laterally to the mandibular rami.	Around the natural orifices of the head except one of them on the vault.

• Arrangement of the fibers	Straightly from the lateral wall of the skull to the mandible	According the situation, they can be in radial or circular shape around the orifices.
• Functions (actions)	Mastication and participate in the articulation of language.	They can act as sphincters or dilators of the orifices and produce folds in the skin to enable us to express feelings and emotional state. Also take part in the articulation of language.
• Embryological origin	Derived from the first branchial arch (mandibular arch)	Derived from the second branchial arch (hyoid arch)
• Nerve-supply	Trigeminal nerve (V CN)	Facial (VII CN)

MUSCLES OF MASTICATION

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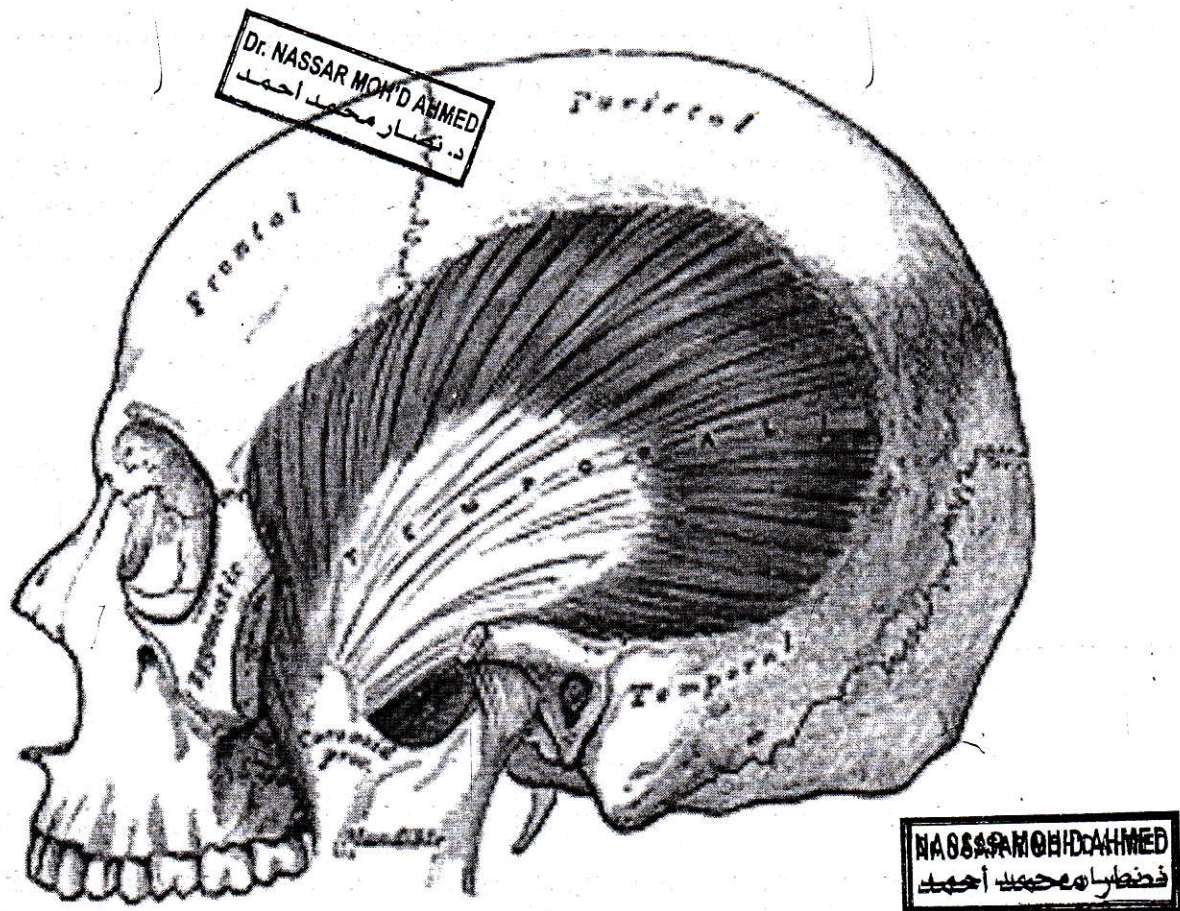
1. **THE TEMPORAL** is a broad, radiating (fan-shaped) muscle, *situated* at the side of the head. It *arises* from the **whole of the temporal fossa** (except that portion of it which is formed by the zygomatic bone) and from the deep surface of the temporal fascia. Its fibers *converge* as they descend, and end in a tendon, which passes deep to the zygomatic arch and is *inserted* into the medial surface, apex, and anterior border of the **coronoid process**, and the **anterior border of the ramus of the mandible** nearly as far forward as the last molar tooth. We can distinguish two parts according the direction of the fibers:

- Anterior part with vertical fibers, and
- Posterior part with horizontal fibers.

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- **Actions:** according the direction of the fibers this muscle is:

1. A strong elevator of the mandible to close the mouth (the anterior part).
 2. Participates in the retraction of the mandible (bilateral contraction of the posterior or horizontal fibers)
 3. Participates in the lateral displacement of the mandible to the same side (unilateral contraction of the posterior fibers).
- Blood supply: branches of the superficial temporal artery
 - Nerve supply: posterior branches of the mandibular branch of trigeminal nerve.



The **temporal fascia** covers the temporal muscle. It is a strong, fibrous investment, covered, laterally, by the anterior and superior auricular, by the aponeurotic galea, and by part of the orbicularis oculi muscle. The superficial temporal vessels and the auriculo-temporal nerve cross it from below upward. *Above*, it is a single layer, attached to the entire extent of the superior temporal line; but *below*, where it is fixed to the zygomatic arch; it consists of two layers, one of which is inserted into the lateral, and the other into the medial border of the arch. A small quantity of fat, the orbital branch of the superficial temporal artery, and a filament from the zygomatic branch of the maxillary nerve, are contained between these two layers. It affords attachment by its deep surface to the superficial fibers of the temporal.

2. **THE MASSETER** is a thick, somewhat quadrilateral muscle, consisting of two portions, superficial and deep. It is superficially located and easily recognized when teeth are clenched. It is the strongest of the masticatory muscles.

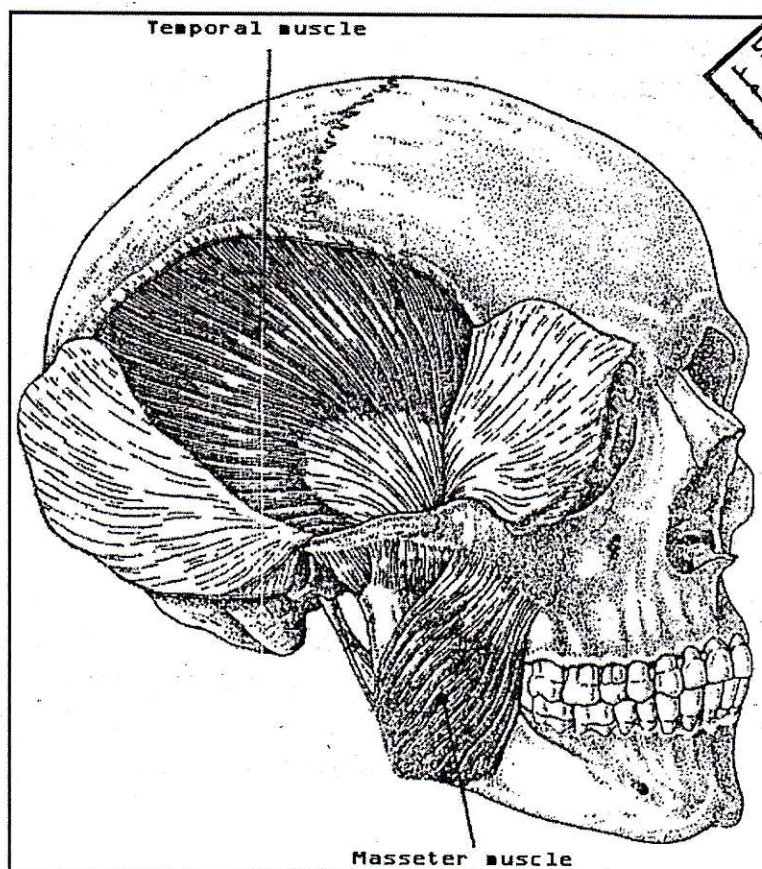
- The superficial portion, the larger, *arises* by a thick, tendinous aponeurosis from the **zygomatic process of the maxilla**, and from the **anterior two-thirds of the lower border of the zygomatic arch**; its fibers pass downward and backward, to be *inserted* into the **angle and lower half of the lateral surface of the ramus of the mandible**.

- The deep portion is much smaller, and more muscular in texture; it *arises* from the **posterior third of the lower border** and from **the whole of the medial surface of the zygomatic arch**; its fibers pass downward and forward, to be *inserted* into the **upper half of the ramus and the lateral surface of the coronoid process of the mandible**. The deep portion of the muscle is partly concealed, in front, by the superficial portion; behind, it is covered by the parotid gland. The fibers of the two portions are continuous at their insertion.

- **Actions:**

1. It is a powerful elevator of the mandible to close the mouth (clenches the teeth).
 2. It may deviate mandible (lateral displacement) to opposite side of the contraction.
 3. It may protrude the mandible in bilateral contraction.
- Blood-supply: masseteric artery from maxillary artery
 - Nerve-supply: masseteric nerve from mandibular branche of trigeminal nerve.

The **Parotideomasseteric Fascia** is covering the Masseter, and firmly connected with it, is a strong layer of fascia derived from the deep cervical fascia. Above, this fascia is attached to the lower border of the zygomatic arch, and behind, it invests the parotid gland.

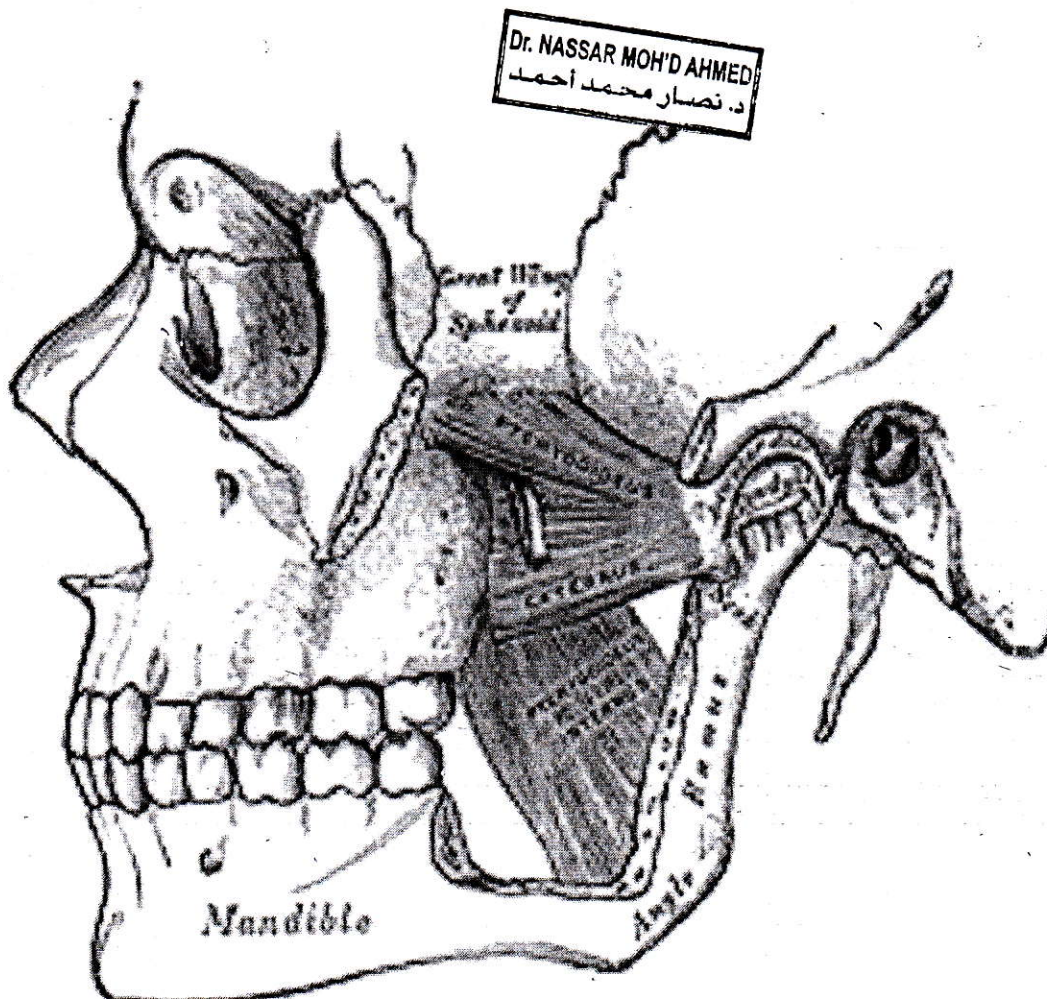


3. **THE MEDIAL PTERYGOID** is a thick, quadrilateral muscle. It *arises* from the **medial surface of the lateral pterygoid plate** and the grooved surface of the pyramidal process of the palatine bone; it has a second slip of origin from the lateral surfaces of the pyramidal process of the palatine and **tuberosity of the maxilla**. Its fibers *pass* downward, lateralward, and backward, and are *inserted*, by a strong tendinous lamina, into the **lower and back part of the medial surface of the ramus and angle of the mandible**, as high as the mandibular foramen.

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• **Actions:**

1. Elevates the mandible to close the mouth (clenches the teeth)
 2. It can protrude the mandible in combination with the lateral pterygoid (in bilateral contraction)
 3. In unilateral contraction contributes to the lateral displacement.
- Blood-supply: medial pterygoid artery from maxillary artery.
 - Nerve-supply: medial pterygoid nerve from mandibular branch of trigeminal nerve.

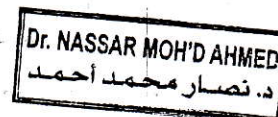


4. **THE LATERAL PTERYGOID** is a short, thick muscle, somewhat conical in form, which extends almost horizontally between the infratemporal fossa and the condyle of the mandible. It *arises* by two heads; an **upper** from the lower part of the lateral surface of the **great wing of the sphenoid** and from the infratemporal crest; a **lower** from the lateral surface of the **lateral pterygoid plate**. Its fibers pass horizontally backward and lateral-ward, to be *inserted* into a depression in front of the **neck of the condyle of the mandible**, and into the front margin of the articular disk of the temporomandibular articulation.



• **Actions:**

1. If both are contracted they protrude the mandible.
 2. If one is contracted the mandible will rotate about the opposite condyle.
 3. They also assist suprahyoid muscles in depression of the mandible to **open** the mouth.
- Blood-supply: lateral pterygoid artery from maxillary artery.
 - Nerve-supply: lateral pterygoid nerve from mandibular branch of trigeminal nerve.



MUSCLES OF FACIAL EXPRESSION

EPICRANIAL MUSCLES

Name	Origin	Insertion
1. Occipitofrontalis muscle	Supraorbital margin, skin of forehead and eyebrows.	Galea aponeurotica
a) Frontal belly		
b) Occipital belly	Supreme nuchal line	Galea aponeurotica
2. Temporoparietalis muscle	Superficial lamina, temporal fascia near ear	On skin and temporal fascia above and in front of ear.
Action: Moves scalp, wrinkles forehead.		

EXTRA-ORBICULAR MUSCLES

Name	Origin	Insertion
3. Orbicularis oculi muscle		
a) Orbital portion	Frontal process of maxilla, medial angle of eye and medial palpebral ligament.	Surrounds orbital opening as a sphincter, some fibers go to eyebrow.
b) Palpebral portion	Medial palpebral ligament.	Lateral palpebral raphe.
c) Lacrimal portion	Posterior lacrimal crest.	Tarsus of each eyelid.
4. Depressor supercilii muscles	Nasal process of frontal bone	Skin of eyebrow.
Action: Close lids, comprises lacrimal sac, moves eyebrows.		
5. Corrugator supercilii muscle	Nasal process of frontal bone.	Skin of eyebrow.
6. Procerus muscle.	Bridge of nose and lateral nasal cartilage.	Skin of forehead between eyebrows.
Action: Acts upon skin of forehead (glabella) and eyebrows.		

PERINASAL MUSCLES (OF THE NOSE)

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Name	Origin	Insertion
7. Nasalis muscle		
a) Transverse part	Area over canine teeth (the maxilla).	Aponeurosis over bridge of nose.
b) Alar part	Area over the lateral incisor (alar cartilage)	Skin at tip of nose.
c) Depressor septi muscle	Incisive fossa of maxilla.	Alar cartilage and septum of nose.
Action: Slightly moves nose, namely, ala of the nose (dilates and contracts nostrils).		

PERI-ORAL MUSCLES

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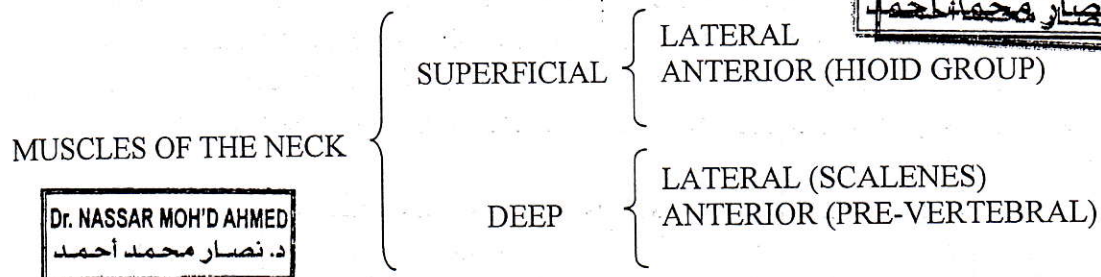
Name	Origin	Insertion
8. Levator labii superioris alacque nasi muscle	Frontal process of maxilla	Ala of nose and upper lip.
9. Levator labii superioris muscle	Infraorbital margin	Ala of nose and upper lip.
10. Zygomaticus minor muscle	Malar surface of zygomatic.	Near angle of mouth,
11. Zygomaticus major muscle	Lateral surface of zygomatic bone.	Angle of mouth.
12. Risorius muscle (a part of the Platysma)	Masseteric fascia	Angle mouth.

13. Depressor anguli oris muscle.	Oblique line of mandible.	Angle of mouth, lower lip.
14. Levator anguli oris muscle.	Canine fossa of maxilla.	Musculature of upper lip, angle of mouth.
15. Depressor labii inferioris muscle.	Mandible between symphysis and mental foramen.	Lower lip.
16. Orbicularis oris muscle: a) Marginal part b) Labial part	a) Fibers blended with adjacent muscles. b) Fibers restricted to lips	Protrude and shapes lips.
17. Buccinator muscle	Outer surface of mandible; alveolar process of maxilla; pterigomandibular raphe.	Angle of mouth and lips. Its interlacing fibers contribute to Orbicularis oris.
18. Mentalis muscle	Incisive fossa of mandible.	Skin of chin.
Actions: Move lips, ala of nose, cheeks, skin of chin. Risorius: draws angle of mouth laterally (smiling).		

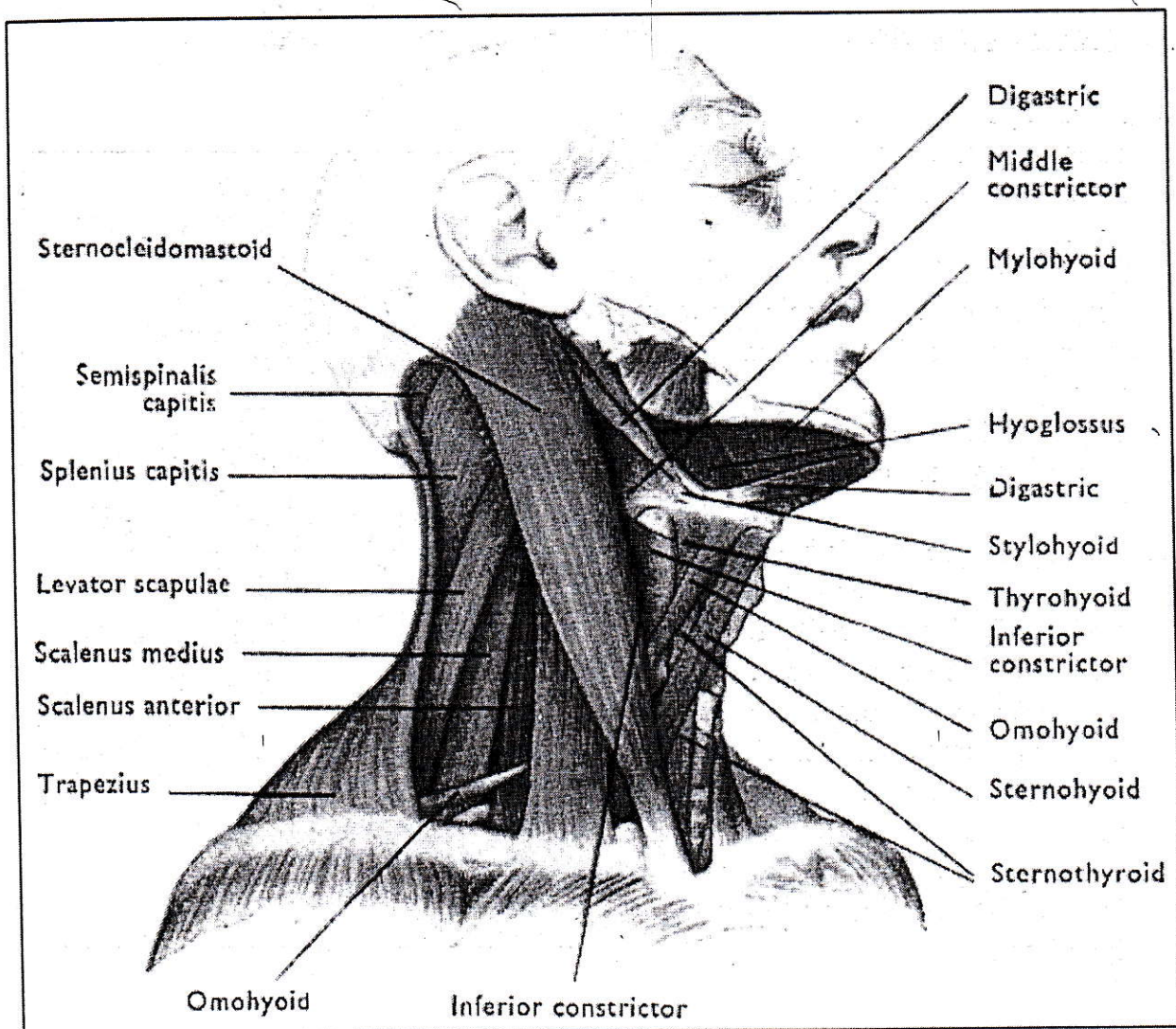


MUSCLES OF THE NECK

Here we are going to study the ventro-lateral muscles of the cervical region because those placed dorsally will be study with the muscle of the back (dorsum). They are divided to study in the following way:



In general, they are responsible of the great mobility of the cervical region of the vertebral column and moreover produce movements concerning deglutition, respiration and phonation.



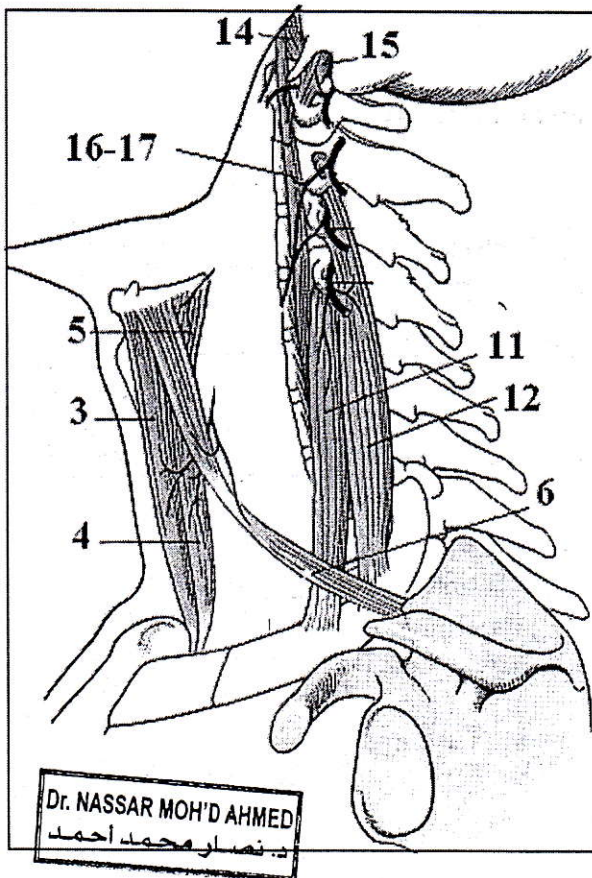
SUPERFICIAL LATERAL MUSCLES

1. **Platysma muscle:** it is considered among facial expression muscles because is a subcutaneous muscle. **Action:** traction of the skin of the neck and also help in depression of the mandible.
2. **Sternocleidomastoid:** originated from two heads: one from the upper part of the anterior surface of the manubrium sterni (sterna; head), and the other from the anterior surface of the medial third of the clavicle (clavicular head). It passes obliquely upwards to be inserted in the mastoid process by a strong tendon and the superior nuchal line in its lateral half by an aponeurosis. (See picture in previous page).
Action: it draws the mastoid process towards the shoulder and turns the face upwards towards the opposite side. If both are contracted, the head is extended (dorsal flexion) if the head is fixed the muscles elevate the sternum and first rib (in deep, forced inspiration).

SUPERFICIAL ANTERIOR MUSCLES

A. Infrahyoid muscles

3. **Sternohyoid muscle:** from the posterior surface of the medial end of the clavicle and manubrium sterni to the hyoid bone.
4. **Sternothyroid muscles:** attached to posterior surface of manubrium sterni to the oblique line of the thyroid cartilage.
5. **Thyrohyoid muscle:** from oblique line of thyroid cartilage to hyoid bone.
6. **Omohyoid muscle:** it has a superior and inferior belly with intermediate tendon. The inferior belly attached to the upper border of scapula close to the scapular notch. It passes obliquely across the neck and an intermediate tendon is attached to the medial end of the clavicle. The superior belly passes up from the intermediate tendon to the body of hyoid bone.



Actions of these muscles:

- Depress the hyoid bone or fix it while the suprahyoid muscles act.
- Thyrohyoid elevates the larynx while the sternothyroid depresses it.
- Used in phonation and swallowing.



B. Suprahyoid muscles

7. Mylohyoid muscle: arise from the median raphe of the floor of the mouth. Its insertion is laterally to the anterior 4/5 of mylohyoid line of mandible.

Action: it takes part in swallowing presses the tongue upwards against the mouth roof. Also opens mouth against résistance.

8. Stylohyoid muscle: originates at the styloid process of the temporal bone. Insertion: hyoid bone.

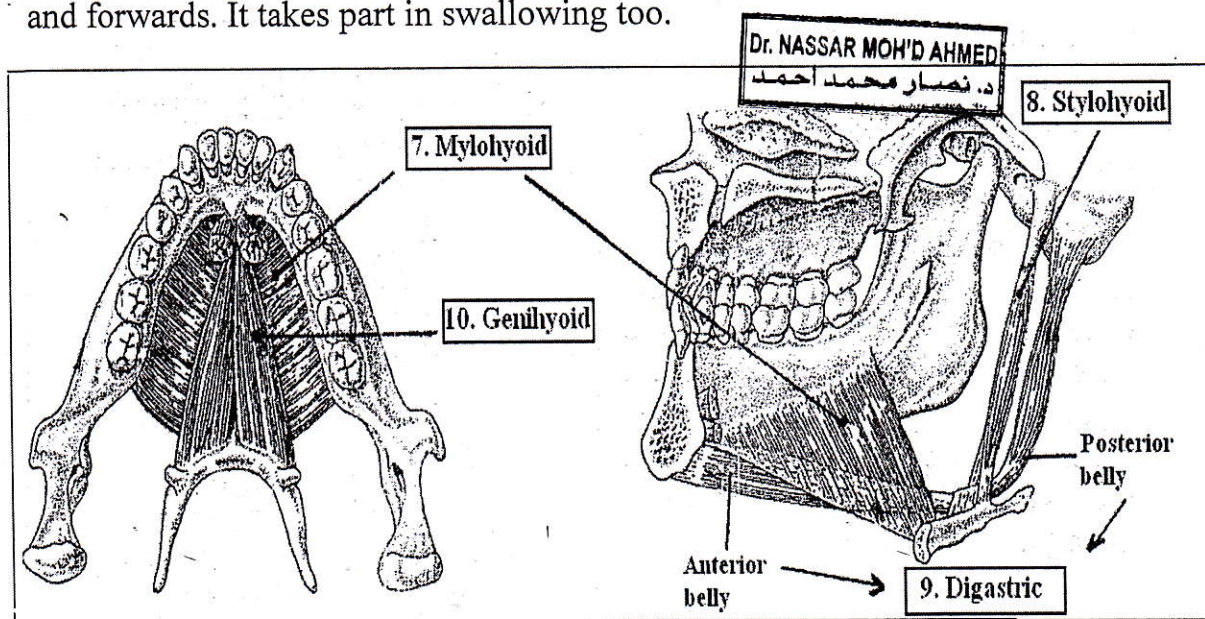
Action: it draws the hyoid bone backwards and upwards participating of swallowing.

9. Digastric muscle: it has two belly joined by a tendon attached to the hyoid bone. The anterior belly is attached to the symphysis menti. The posterior belly is attached to the mastoid process.

Action: to open the mouth against resistance and raise the hyoid bone taking part in swallowing too.

10. Geniohyoid muscle: attached to the mental spine its insertion is also in the hyoid bone.

Action: to open the mouth against resistance and pull the hyoid bone upwards and forwards. It takes part in swallowing too.



In general, the suprahyoid muscles descend de mandible to open the mouth if the hyoid is fixed by the infrahyoid group. Otherwise, they elevate the hyoid bone during the deglutition process (swallowing) because most of them are forming part of the floor of the mouth.

DEEP LATERAL MUSCLES: "Scalene muscles"

The scalene muscles connect the transverse processes of the cervical vertebrae with the first and second ribs.

Actions: they raise the first and second ribs in inspiration. When the first and second ribs are flexed they flex the cervical part of the vertebral column but when one side only contracts it will produce lateral flexion the cervical column.

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11. The anterior scalene muscle extends from the transverse processes of the 3rd to 6th cervical vertebrae to the scalene tubercle of the first rib (between the two subclavian grooves). Its proximity to the brachial plexus, subclavian artery and subclavian vein can give rise to "compression syndromes".

12. The middle scalene extends from the transverse process of the 2nd to 6th cervical vertebrae to the upper surface of the first rib behind the groove for the subclavian artery.

13. The posterior scalene muscle (smallest) from the middle cervical vertebrae to the second rib behind the serratus anterioris muscle.

DEEP ANTERIOR MUSCLES: "Pre-vertebral muscles"

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14. Rectus capitis anterior

15. Rectus capitis lateralis

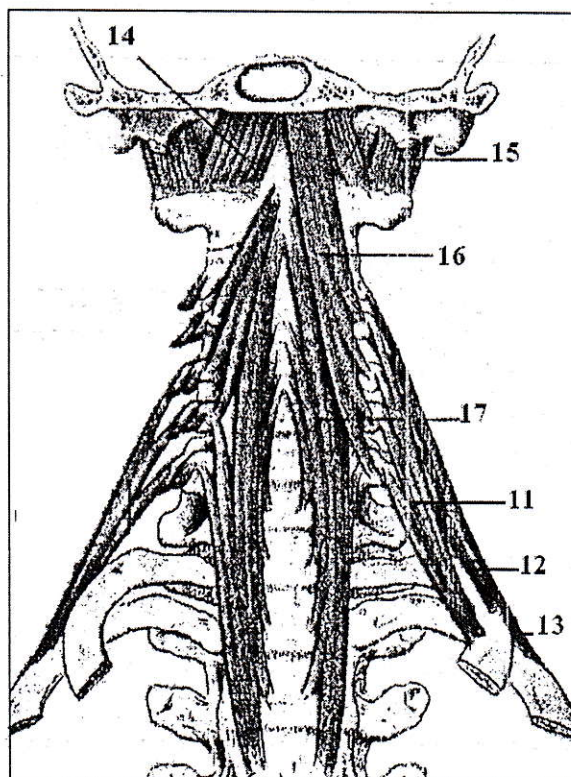
16. Longus capitis

17. Longus colli

These muscles are situated in front of the cervical portion of the vertebral column, extended from the cranial base to the third thoracic vertebra. Along their course, they attach to the bodies and transverse process of all cervical and upper three thoracic vertebrae.

Actions:

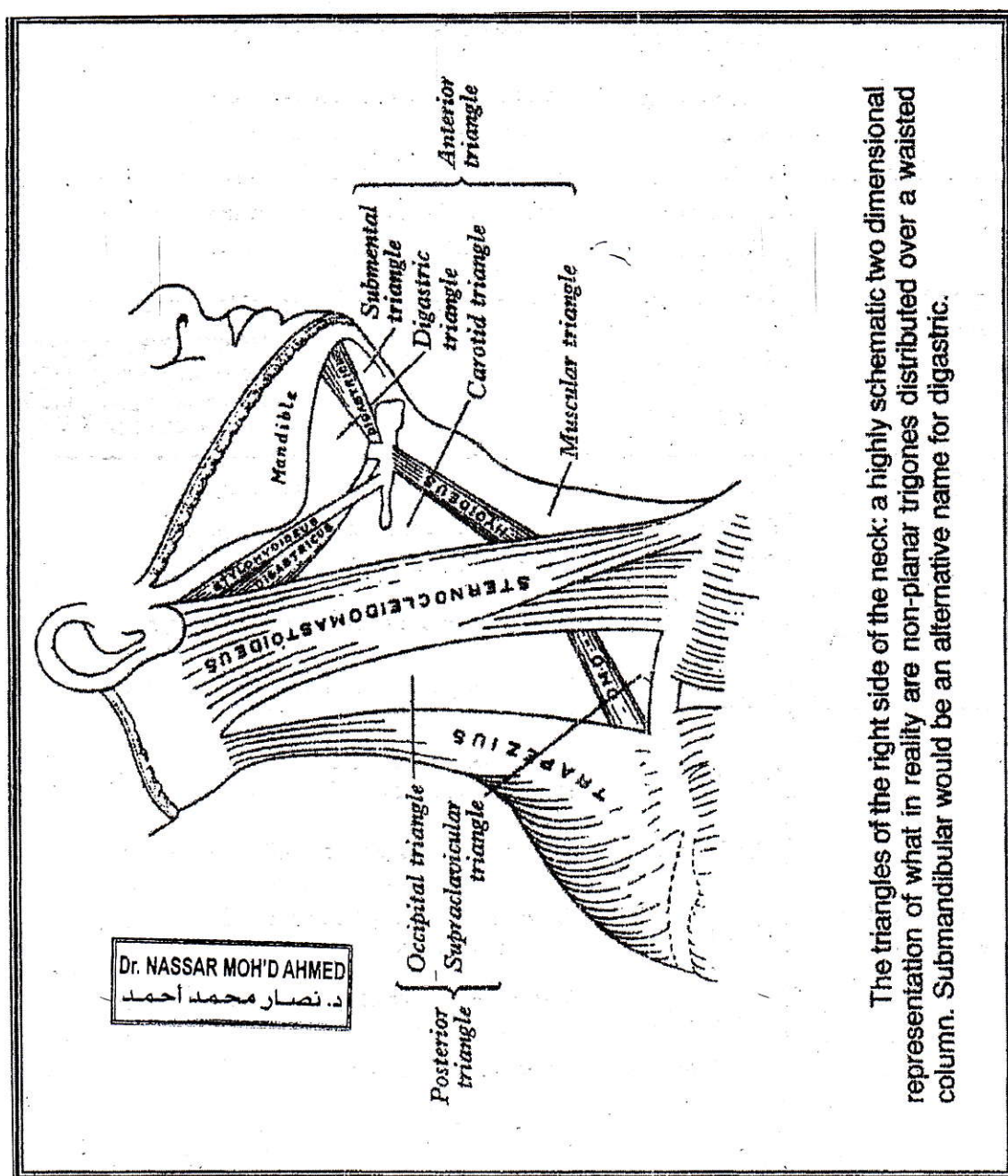
- Flexion of the head forwards and laterally
- Rotatory movement of the head and neck.



COMPLEMENTARY or ANNEXE INFORMATION ABOUT:

TOPOGRAPHIC DIVISION OF THE NECK

Muscles, clavicle, mandible, sternum and hyoid bone divide the neck into a number of “**triangles**”. They are important landmarks for clinical examination and surgical procedures of the neck.



The triangles of the right side of the neck: a highly schematic two dimensional representation of what in reality are non-planar trigones distributed over a waisted column. Submandibular would be an alternative name for digastric.

(A) ☉ Anterior

(B) ■ Posterior

Name Of The Triangle		Bounder
(A) ☉ Ant. Triangle	☉ Posteriorly	The ant. Border of the sternocleidomastoid
	☉ Anteriorly	Middle line of the neck
	☉ Superiorly	The lower margin of the mandible and the line continued back from the angle of the mandible to the mastoid process

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☉ The Anterior Triangle Is Subdivided By The Omohyoid Muscle Into 3 Triangles

(1) ● Submandibular Triangle	● Posteriorly	Pos. belly of the digastric muscle
	● Anteriorly	Ant. belly of the digastric muscle
	● Superiorly	Lower border of the mandible
(2) ■ Carotid Triangle	■ Posteriorly	Upper half of the sternocleidomastoid
	■ Anteriorly	Sup. Belly of the omohyoid muscle
	■ Superiorly	Pos. belly of the digastric muscle
(3) ◆ Muscular Triangle	◆ Posteriorly	The lower half of the sternocleidomastoid
	◆ Anteriorly	Middle line of the neck
	◆ Superiorly	Sup. Belly of omohyoid

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(B) ■ Pos. Triangle	■ Posteriorly	Ant. Border of the trapezus muscle
	■ Anteriorly	Pos. border of the sternocleidomastoid
	■ Inferiorly	The middle third of the clavicle bone

■ The Posterior Triangle Is Subdivided By The Omohyoid Muscle Into 2 Triangles

(1) ● Occipital Triangle	● Posteriorly	The upper part of the ant. Border of trapezius muscle
	● Anteriorly	The upper part of pos. border of sternocleidomastoid
	● Inferiorly	Upper border of inf. Belly of omohyoid muscle
(2) ● Supraclavicular Triangle	● Anteriorly	Lower part of the pos. border of sternocleidomastoid
	● Superiorly	The lower border of inf. Belly of omohyoid muscle
	● Inferiorly	Upper of middle third of clavicle

GUIDE FOR PRACTICE CLASS # 7

Theme: Muscles of the head and neck

Summary: 1. Muscles of the head.

- a) Muscles of the mastication.
- b) Muscles of facial expression.

2. Muscles of the neck.

- a) Superficial muscles.
- b) Anterior group.
- c) Deep group.

3. Surface anatomy.

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Objectives:

1. To classify the group of muscles of the head and neck, describing briefly the general and particular characteristics.
2. To identify these muscles in the dissected anatomical pieces and models, characterizing its muscular action.
3. To identify the most relevant muscles on the surface of the head and neck.

Methodological Orientations (TASK)

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1. Indicate in the cadaver the muscular groups of the head and explain its general characteristics.
 - Utilize the Atlas, fig. 282 to 287.
 - For description the general characteristics it is necessary to proceed what is mentioned in the general orientations study of myology.
 - To facilitate the study you should make a summary in a table.
2. Identify the anatomical pieces the muscles of mastication and describe each one its particular characteristics.
 - In order to facilitate the study and precise the particular characteristics you should note the procedures mentioned in the general orientations of study myology, and make accordingly a summary in a table.
 - Utilize the Atlas, fig 285 to 288.
 - Observe the direction of the muscle fibers and its attachments on the bone in order to analyze the muscle action.
 - Do by yourself the movements of the temporo-mandibular joint mentioning the names and the muscles that produces these movements.
3. Identify in the anatomical pieces, the muscles of the facial expression and describe its particular characteristics.

- To describe the particular characteristics of these muscles it is necessary to distinguish the muscles subgroup division, the name, situation and the action of each muscle.
- Utilize the Atlas, fig 282, 284 and 285.
- Do by yourself the movements of the muscles of face and mention the action of each muscle.

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4. Indicate the muscle groups of the neck in the dissected cadaver and explain the general characteristics of each group.
 - Utilize the Atlas, fig. 274 to 281.
 - To facilitate the study you should make a summary or a table for the particular characteristics.
 - Identify the superficial muscles.
 - Observe the direction of the muscular fibers and its extension between the bones. Remember that some of these muscles can change their fix and mobile ends.
 - Do by yourself the movements produced by these muscles and mention the names of muscles producing each movement.
5. Identify the most markable muscles on the surface of the head and neck:
 - Close the mouth strongly and then palpate the Masseter muscle.
 - The contraction of facial muscles will produce some facial expression. So, make a contraction of the following muscles and interpretate the determined expression provided:

Muscle	Expression of
Anterior belly of occipito-frontalis	Attention or surprise
Corrugator supercilii	Suffering or worry
Procerus	Struggle, fight
Mentalis	Doubt
Depressor labii inferioris	Irony
Depressor angulis oris	Sadness
Risorius	Smiling
Zygomaticus major and minor	Happiness or laugh
Levator anguli and labii superioris	Neglect, contempt or displeasure

- It is possible to observe the platysma muscle when the sternocleidomastoid contract, so draws the mastoid process to the shoulder and turn the face to the opposite side.

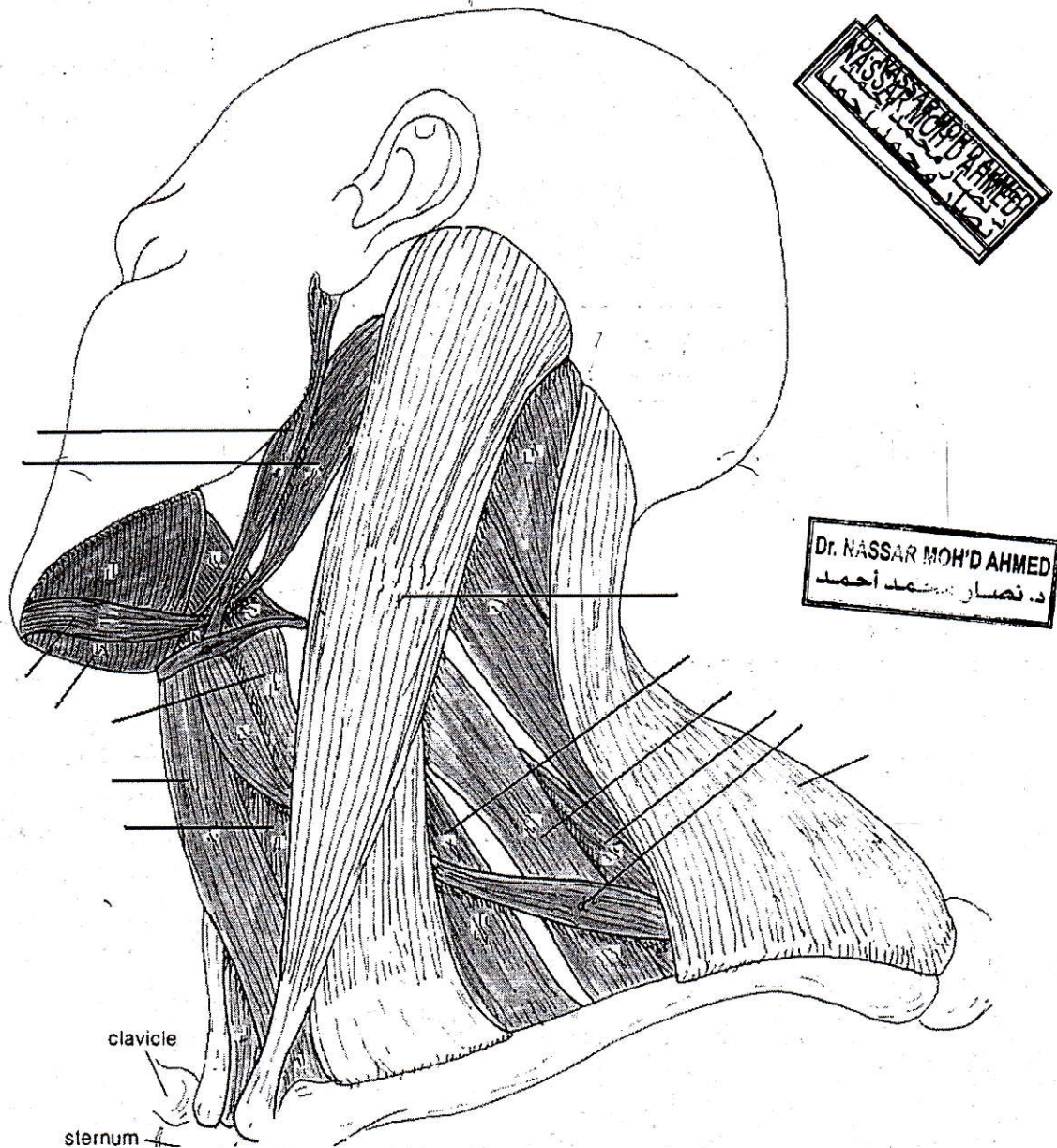
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Bibliography:

- Cunningham's textbook of Anatomy. 12th edition. Pages 281 to 296.

- Sobotta/figge. Atlas of Human Anatomy. Vol 1. Pages 168 to 188.
- You may use the Learning guide for Practical Anatomy I (booklet), pages 23-24, to see more details about examination of the masticatory muscles.

Identifying the possible muscles of the neck in the following drawing:



UNIVERSITY OF ADEN. FACULTY OF MEDICINE AND HEALTH SCIENCES
DEPARTMENT OF MORPHOLOGICAL SCIENCES
HUMAN ANATOMY I FOR MEDICAL STUDENTS

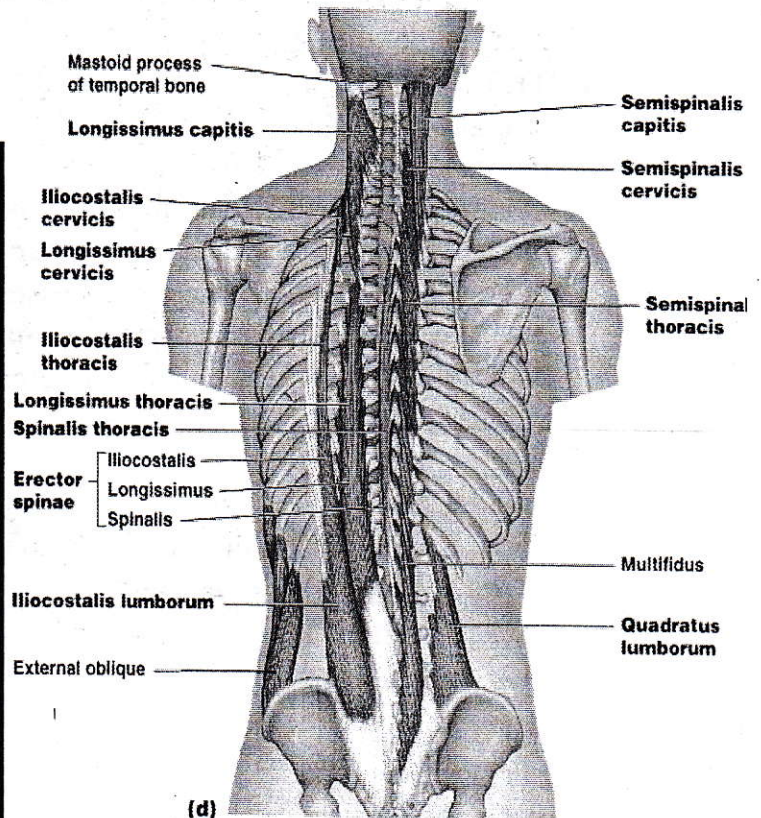
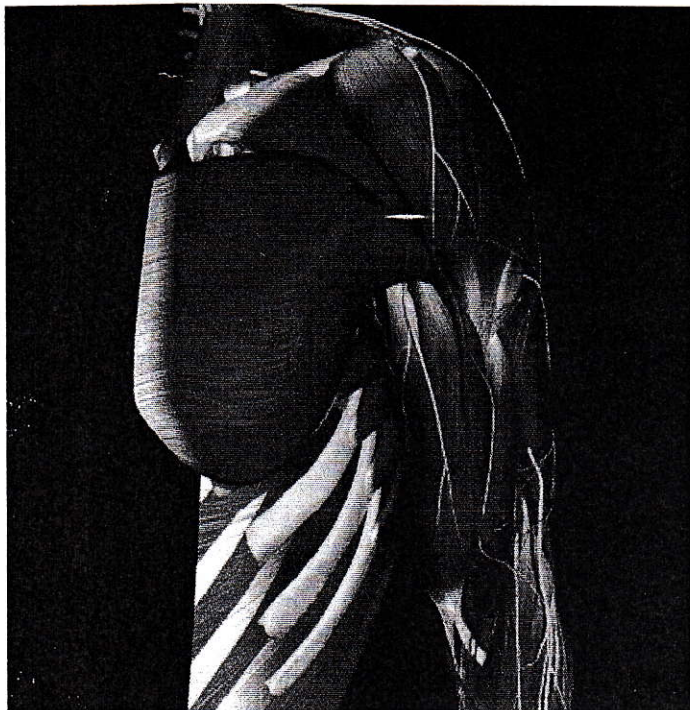


MUSCLES OF THE TRUNK

PART 1

(LECTURE 11)

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The **MUSCLES OF THE TRUNK** can be divided into four groups:

1. Muscles of the back.
2. Muscles of the thorax.
3. Muscles of the abdomen.
4. Muscles of the perineum.

(This last group is usually described at the end of the urogenital system because of their anatomical and functional relations with those organs).

MUSCLES OF THE BACK

They are arranged into two groups: **superficial** and **deep** (sometimes an intermediated group is described).

A. SUPERFICIAL GROUP

General characteristics:

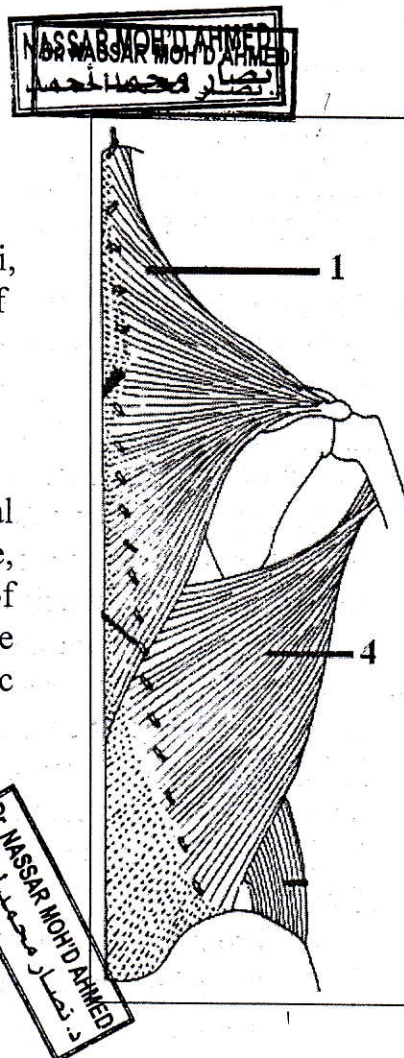
- Located superficially in the back.
- They originate from the vertebrae.
- With the exception of the latissimus dorsi, they are inserted to and move the bones of the shoulder girdle.

1. **Trapezius:** superficial, large, triangular muscle on the back of the neck and trunk.

Origin: medial third of superior nuchal line, external occipital protuberance, indirectly in the spinous processes of cervical vertebrae by the ligament nuchae and spinous processes of all thoracic vertebrae.

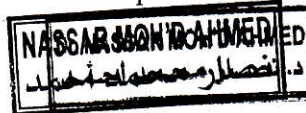
Insertion:

- Upper fibers in the lateral third of clavicle.
- Middle fibers in the acromion and spine of scapula.
- Lower fibers in the medial end of spine of scapula.



Actions:

- Upper fibers elevate the shoulder girdle.
- Lower part depresses the shoulder girdle.
- Middle part retracts (move backwards) the scapula.
- Both muscles acting simultaneously extend the head.
- Combined contractions can rotate the scapula laterally.
- It is also a climbing muscle.



2. Levator scapulae

Origin: posterior tubercles of transverse processes of first three of four cervical vertebrae.

Insertion: superior angle of scapula.

Action: elevates and fixes the scapula.

3. Rhomboid muscles (minor above, and major below, beneath trapezius separated both by a narrow cleft).

Origin: spines of the 7th cervical and upper five thoracic vertebrae.

Insertion: medial (vertebral) border of the scapula opposite to and below the spine.

Action: retractor (backward movement), also elevator and rotator of the scapula.

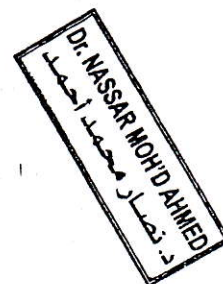
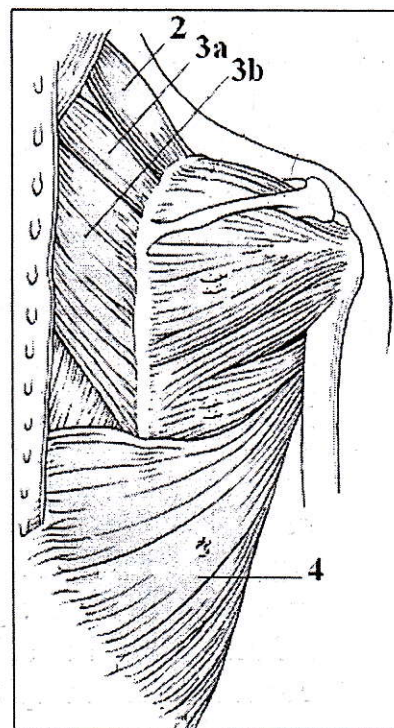
4. Latissimus dorsi: large, triangular, wide muscle at the lower back of the trunk. (See the two previous pictures)

Origin: spines of lower six thoracic and all lumbar vertebrae, thoraco-lumbar fascia, iliac crest, lower ribs and inferior angle of scapula.

Insertion: floor of the inter-tubercular sulcus of humerus.

Actions:

- Strong extensor (retro-flexor) of the arm.
- Powerful adductor of humerus and rotates it medially.
- Important climbing muscle.
- Powerful muscle in rowing and swimming.
- It acts in violent expiration (coughing, sneezing).



B. INTERMEDIATE GROUP

5. **Serratus posterior-superior:** extended from the spines of seventh cervical and the upper three to four thoracic vertebrae, and inserted into 2nd-5th ribs.

Action: elevates the upper ribs during inspiration.

6. **Serratus posterior-inferior:** lying below the latissimus dorsi, and taking origin from the thoraco-lumbar fascia, and inserted into the last four ribs.

Action: depresses the lower ribs during expiration.

C. DEEP GROUP

General characteristics:

- Included vast numbers of small muscles and muscle bundle that make up the intrinsic back muscles.
- They form a pair of broad, longitudinally oriented bundles on either side of the spines of vertebrae, lodged in the groove between the vertebral spinous and transverse processes and the angles of the ribs, and extended from the sacrum to the skull.
- They are attached to vertebral column from the ilium and ribs.
- They act to extend, bend laterally and rotate the vertebral column and head.
- They regulate the posture of vertebral column by counteracting the force of gravity that tends to flex the vertebral column.

7. **Splenius capitis and cervicis:** broad muscle placed at the floor of the posterior triangle of the neck deep to the sternocleidomastoid and trapezius.

Origin: lower portion of ligament nuchae and spines of upper four or five thoracic vertebrae.

Insertion: posterior tubercles of the transverse processes of the upper three or four cervical vertebrae mastoid process.

Actions:

- In bilateral contraction → extension of head and neck.
- In unilateral contraction → lateral flexion and rotation of the cervical portion of the vertebral column to the same side and turn the face to the same side.

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8. **Erector spinae:** large, powerful muscle extended at the sides along whole vertebral column from the sacrum and hipbone to the head.

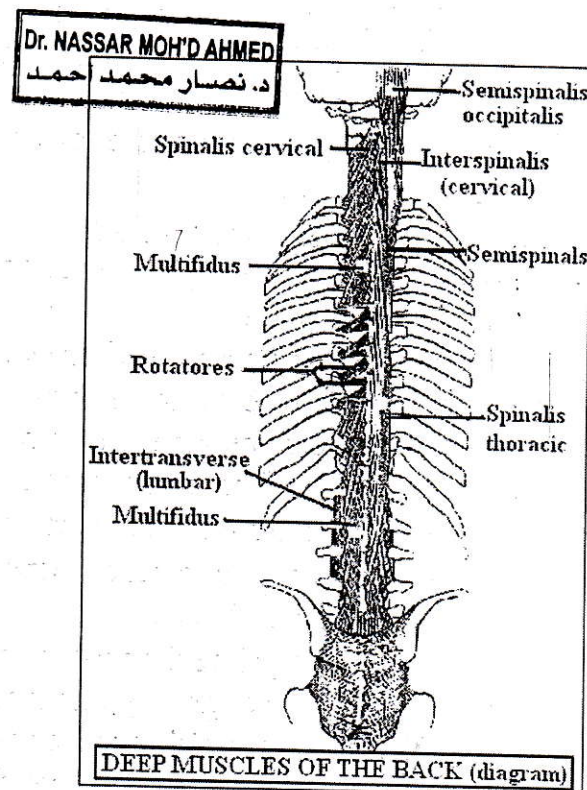
Origin: lower two thoracic spines, all lumbar spines, dorsal surface of sacrum and iliac crest.

Insertion: along their course, the muscular fibers attach successively in the ribs and transverse processes of vertebrae and skull. As the muscular mass reaches the level of the 12th rib, it divides into three columns:

- Lateral → **iliocostalis**
- Intermediate → **longissimus**
- Medial → **spinalis**

Actions:

- Primary, it is responsible for the maintenance of vertebral curvatures in erect and sitting posture.
- In bilateral contraction → extension of the vertebral column.
- In unilateral contraction → flexion and rotation of the column to the same side.
- Active control of the flexion of the vertebral column.
- During walking, it steadies the vertebral column on the pelvis.



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9. **Transversospinalis:** it is a group of short muscles lying deep to the erector spinae. The name of transversospinalis is given because of their fibers run upwards and medially from a transverse process to a spinous process of a vertebra placed superiorly. Like erector spinae, this consists of three components but arranged from superficial layer to deep layer.

- **Semispinalis** (the most superficial). Extended from the long to the skull. Divided into:

- a) Semispinalis thoracis.
- b) Semispinalis cervicis.
- c) Semispinalis capitis.



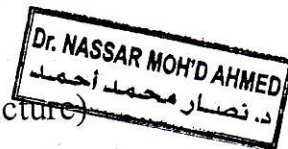
Actions: extension of the vertebral column, head and neck..

- **Multifidus:** intermediate layer placed in the furrow between transverse and spinous processes of the vertebrae. Better developed at the lumbar and cervical regions.

Actions: extension, lateral flexion and rotation of the vertebral column.

- **Rotatores:** the deepest layer. Better developed at the thoracic region.

Actions: rotatory movement of the vertebral column and extensile ligaments.



10. Interspinalis and intertransversarii (See previous picture)

- **The interspinalis muscles** are short, insignificant slips extended between adjacent spinous processes at both sides of the interspinous ligament. Best developed at the cervical and lumbar regions, and may be absent at the thoracic part of column.
- **The intertransverse muscles** are similar small bands between transverse processes in the cervical and lumbar regions.

Actions: Probably "extensile ligaments" guarding the action of the prime movers, assisting in lateral flexion and erection of the vertebral column.

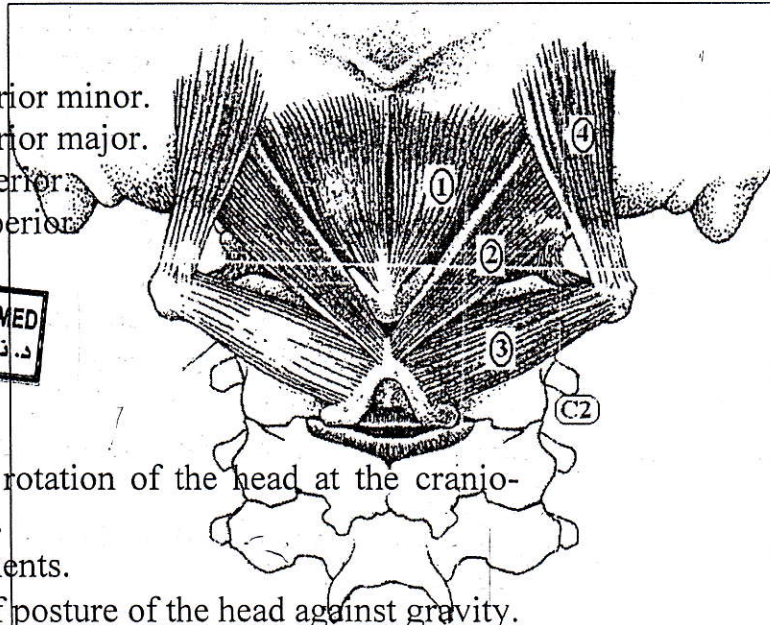
11. Suboccipital group: they are a special deep muscles placed at the back of the neck (in the suboccipital triangle):

1. Rectus capitis posterior minor.
2. Rectus capitis posterior major.
3. Obliquus capitis inferior.
4. Obliquus capitis superior.

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Actions:

- Extension and rotation of the head at the cranio-vertebral joints.
- Extensile ligaments.
- Maintenance of posture of the head against gravity.



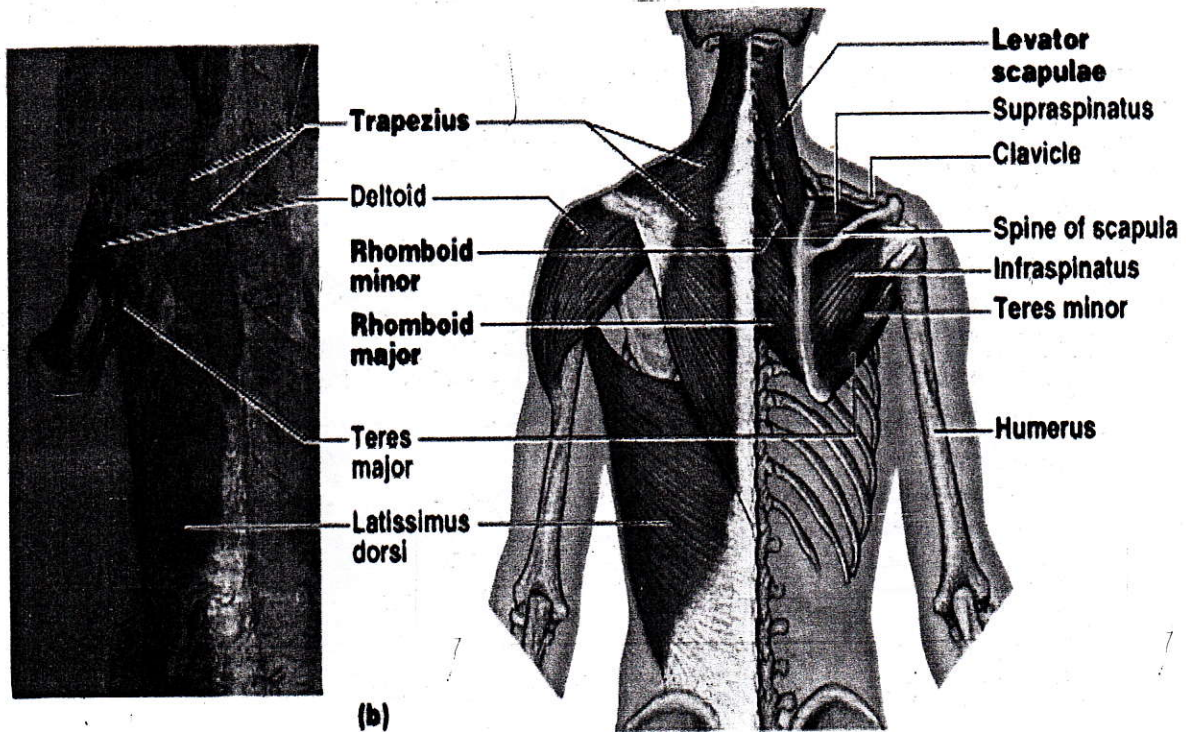
THE THORACOLUMBAR FASCIA

It is a strong development of the deep fascia of the trunk at the level of the sacral, lumbar and lower thoracic regions. It covers the deep muscles of the back and trunk. It also gives attachment to some superficial muscles of the back like latissimus dorsi, trapezius, serratus posterior-inferior.

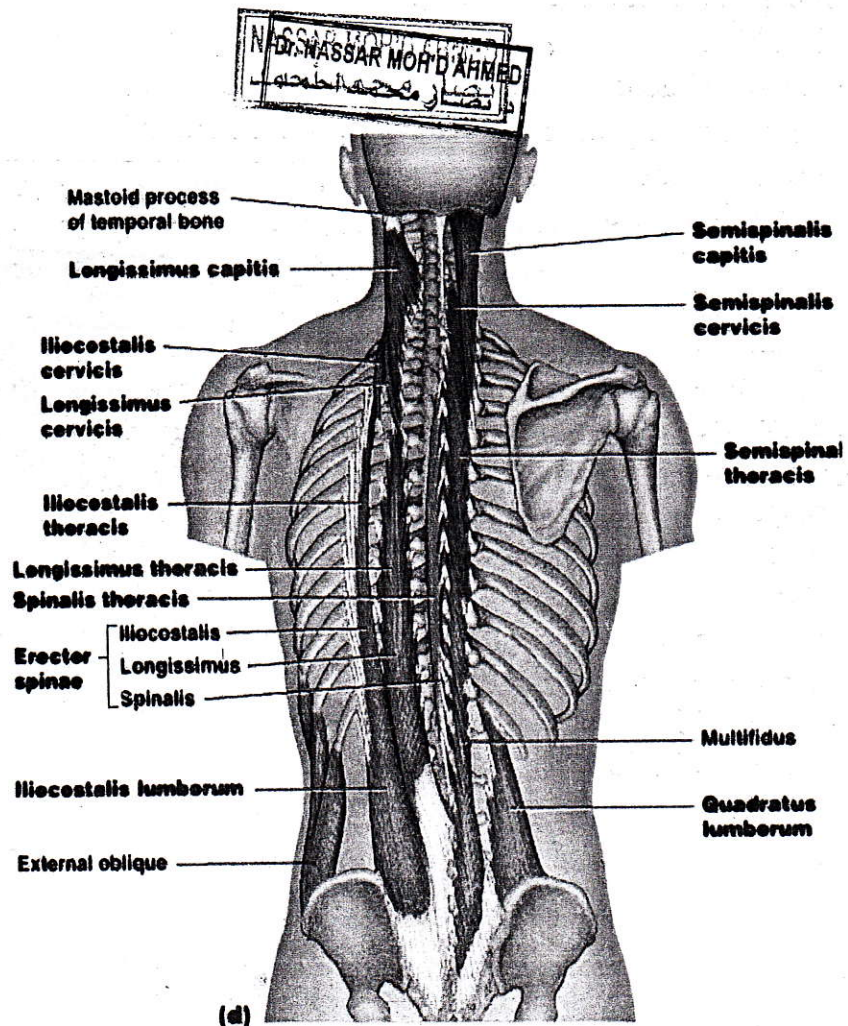
LIGAMENTUM NUCHAE

It is an enlargement of the supraspinous ligament in the neck. In man, it is merely a triangular, thin, fibro-elastic septum between the muscles of the two sides of the back of the neck. It is continuous behind with the ligament nuchae, giving attachment and covering to trapezius muscle.

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MUSCLES OF THE THORAX

The muscles of the thorax are described as arranged into two groups:

- A. **Superficial** → muscles that connect the upper limb to the thoracic wall
- B. **Deep or thoracic muscles proper** → they attach to the ribs, thus playing important function in the respiratory movements.

SUPERFICIAL MUSCLES OF THE THORAX

1. **Pectoralis major:** wide, fan-shaped muscle situated at the anterior wall of the chest and axilla.

Origin:

- Clavicular part → medial third of the clavicle.
- Sternocostal part → anterior surface of sternum from 2nd to 6th costal cartilages.
- Abdominal part → small slip from the aponeurosis of the external oblique muscle of abdomen.

Insertion: crest of the greater tubercle of humerus.

Actions:

- Flexion, adduction and medial rotation of arm.
- Climbing muscle.
- Combined action in pushing and throwing.
- Accessory respiratory muscle (forced inspiration).

2. **Pectoralis minor:**

smaller and
beneath
pectoralis
major.

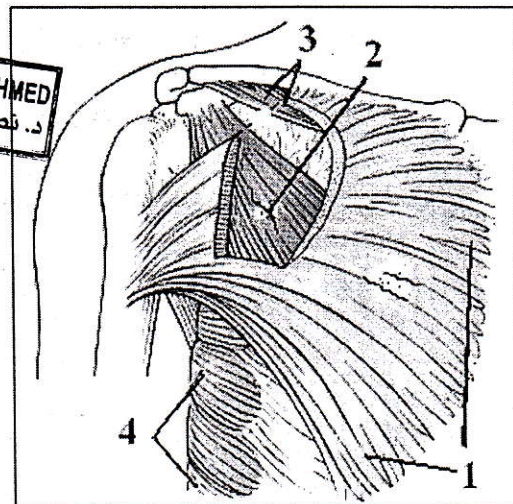
Origin: second to fifth ribs (near the costo-chondral junction).

Insertion: coracoid process of the scapula.

Actions:

- Forward pulling, medial rotation and depression of the scapula and shoulder girdle.
- Helps in respiration

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3. Subclavius muscle: small muscle extended almost horizontally from the upper surface of the first rib (near the costo-chondral junction), to the lower surface of the acromial (lateral) end of the clavicle. (See previous picture)

Action: protective action (control) on the sternoclavicular joint during shoulder girdle movements ('active' ligament of the sternoclavicular joint).

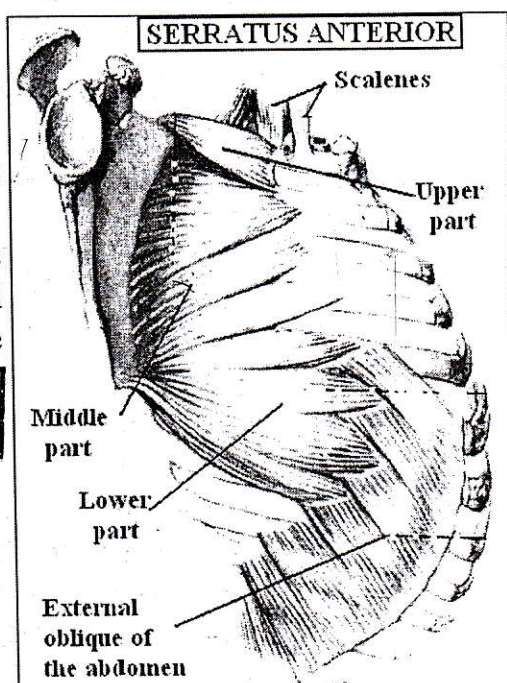
4. Serratus anterior: wide muscle applied to the lateral wall of the thorax.

Origin: by 9 digitations from the upper nine ribs.

Insertion: along whole length of the vertebral (medial) border of the scapula. Sometimes, the muscle is described as having three portions: upper, middle and lower parts. The middle is the weakest; the lower is the strongest.

Actions:

- Holding or steadying the scapula close to the trunk to provide fix platform for the action of other muscles.
- Pulling the scapula forwards as in pushing.
- Lateral rotation of the scapula.



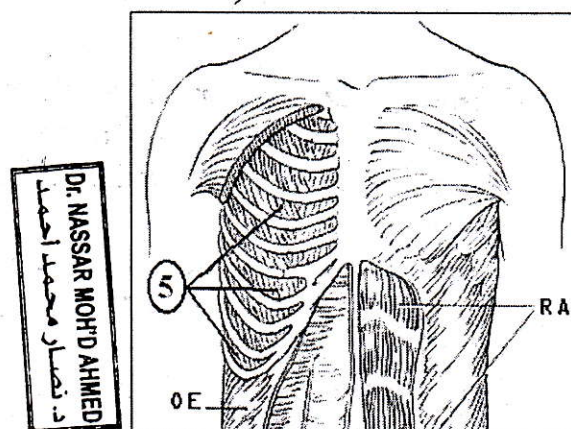
DEEP MUSCLES OF THE THORAX

General characteristics:

- They attach to adjacent ribs, producing their movements during respiration.
- They contribute to form the thoracic walls and protect the thoracic organs.
- They contract rhythmically and involuntarily in the inspiration and in the expiration.
- They act together with the abdominal muscles in the reciprocal control of the intrathoracic and intrabdominal pressure.

5. Intercostales muscles

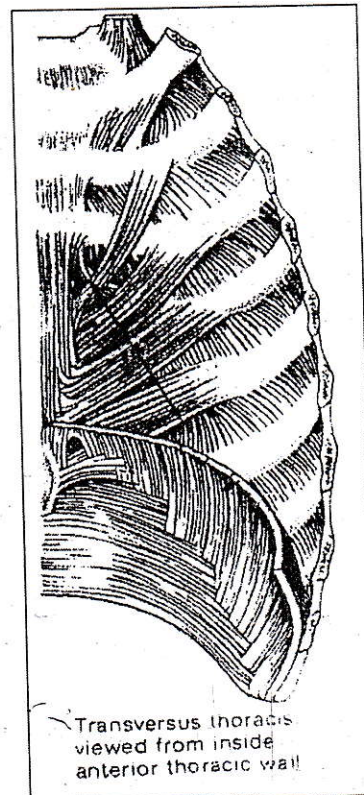
- The **external intercostals muscles** are the outer layer of this group. They run forward and downward from the lower border of the upper rib below. They occupy the intercostals spaces from the tubercle of the rib to the costochondral junction where they continue with the external intercostals membrane.



- The **internal intercostals muscles** are placed deeper to the external intercostals, and their fibers cross with them in opposite direction. They run forwards but upwards from the rib below to the rib above. They occupy the intercostals spaces from the sternum to the angle of the rib, where they continue with the internal intercostals membrane.
- The **intercostals intimi muscles** (innermost intercostals muscles) are frequently poorly developed. They are situated deep to the internal intercostals muscles and with similar direction of the muscular fibers. So, they are functionally part of the intercostals muscles. The intercostals neurovascular bundle courses between them.
- The **subcostals muscles** are irregular, weak slips, varying considerably in number and size, which lie on the inner surface of the lower ribs near their angles. They run in the same direction as the intercostales intimi, passing over one or two intercostals spaces. They may be continuous with the innermost intercostals (intercostales intimi) muscles.

6. **Levatores costarum:** small triangular muscles, arising from the transverse processes of the 7th cervical vertebra to the 11th vertebra. They insert into the external surface of the rib below, lateral to its tubercle.
Action: elevation of the ribs during inspiration.

7. **Transversus thoracic:** It is a weak-developed muscle which extends from the inner (posterior) surface of the sternum to the inner aspect of the costal cartilages.
Action: depression of the costal cartilages joined to sternum so, contributing to expiration.



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Some considerations about actions of intercostals muscles

1. Some **external intercostals muscles** are active during **inspiration**.
2. Also, there are electromyography evidences to suggest that they are active during the first phase of expiration.
3. **Internal intercostals muscles** act in **forced expiration**.
4. Both external and internal intercostals muscles are inactive in quiet expiration.
5. Quiet expiration occurs by relaxation of usual inspiratory muscles.
6. The **subcostal muscles** probably depress the lower ribs.

ENDOTHORACIC FASCIA

The endothoracic fascia is a condensation of loose connective tissue on the internal surface of the thoracic cavity, also investing the organs of the mediastinum. The endothoracic fascia separates the parietal pleura from the walls of the thoracic cavity.

There are two 'planes of cleavage' (possible separation):

1. **Extrapleural plane:** between the pleura and the fascia.
2. **Extrafascial plane:** between the fascia and the walls of the thoracic cavity.

The fascia attaches to the transverse process of the 7th cervical vertebra and to the medial border of the 1st rib.

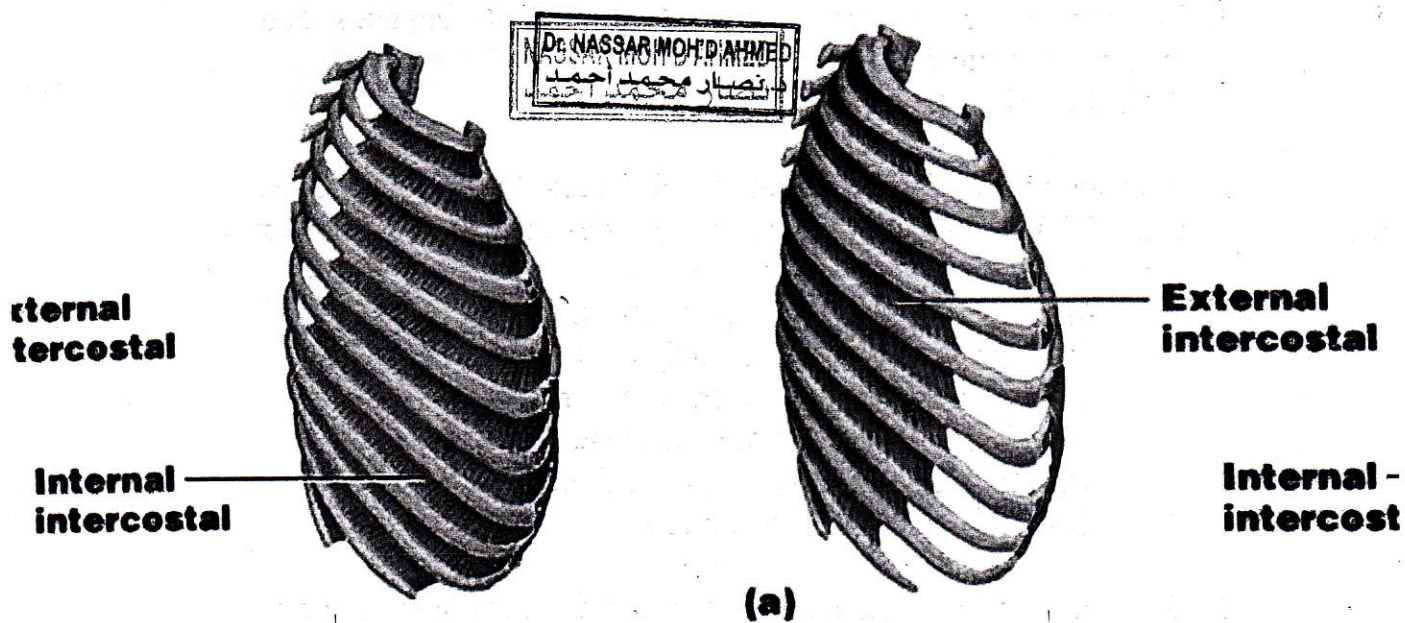
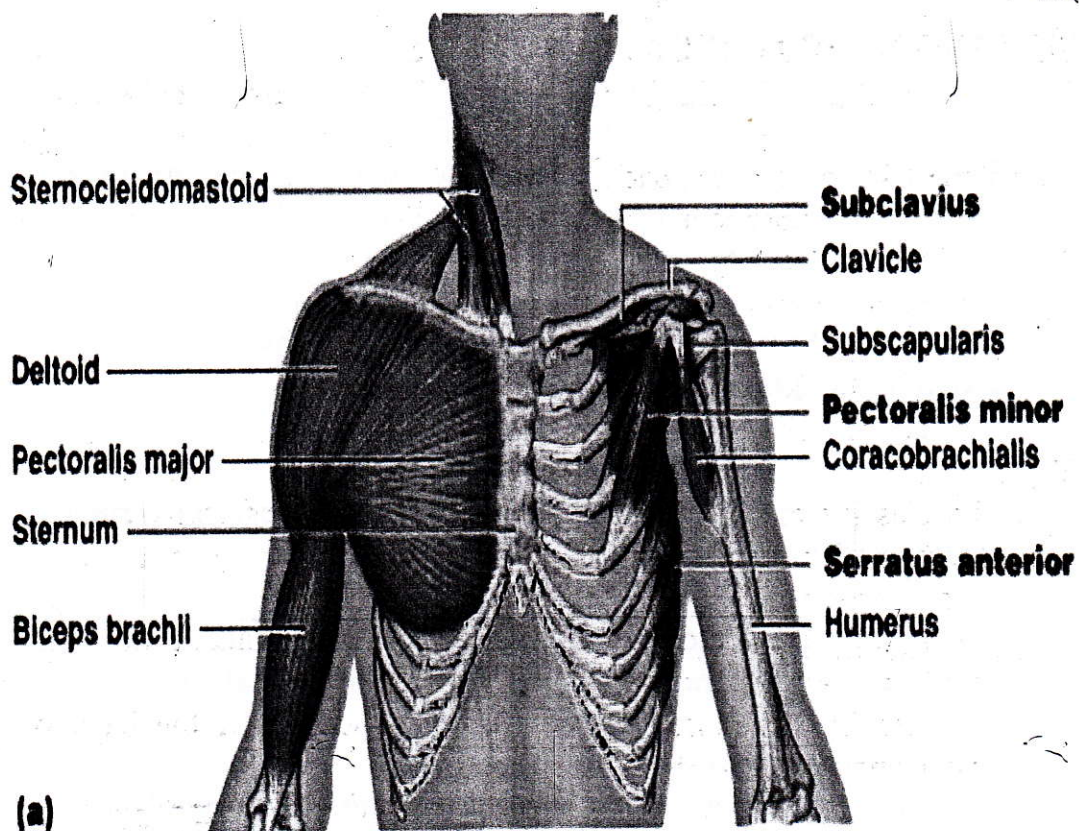
The fascia is thinner on the internal surface of lateral walls of the thorax, where it can be easily separated from the ribs and intercostals muscles,

The fascia is thicker at two sites;

1. Over the apex (cupula) of pleura forming the suprapleural membrane or 'Sibson's fascia'.
2. Over the domes of the diaphragm.



12a



GUIDE FOR PRACTICAL CLASS # 8

Theme: MUSCLES OF THE BACK OF TRUNK AND THORAX

Summary: 1. Muscles of the back of trunk.

- a) Superficial group.
- b) Deep group as a whole.

2. Muscles of the thorax :

- a) Superficial group.
- b) Deep group.

3. Anatomy surface of these regions.

Objectives:

1. To classify the group of muscles of the back of trunk and thorax, describing briefly the general and particular characteristics.
2. To identify these muscles in the dissected anatomical pieces and models, characterizing its muscular action.
3. To identify the most distinct markable muscles of the back of trunk and thorax on the body surface.

Methodological orientations (TASKS)

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1. Indicate in the cadaver the muscle groups of the back and explain the general characteristics.
 - Utilize the Atlas, fig 255 to 258.
2. Indicate in the dissected anatomical pieces the muscles of the superficial group of the trunk and describe the particular characteristics of each muscle.
 - Make a summary or an illustrated table.
 - In order to analyze the muscle action, it should be noted the direction of muscular fibers and between what bones extends. Some of these muscles could vary their ends fix to movable and vice versa.
 - Utilize the atlas, fig 255 and 256.
3. Explain the situation and action of muscles of the deep group of the back of the trunk.
 - Utilize the atlas, fig 256 to 259.

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4. Show in the dissected cadaver the muscle groups of the thorax and explain the general characteristics of each group.
 - Make a summary or an illustrated table.
 - Utilize the Atlas, fig 262, 266 and 269.
5. Identify in the anatomical pieces the muscles of the superficial group of the thorax that inserted in the upper limb and describe the particular characteristics of each muscle.
 - Analyze the action of these muscles according the direction of the muscular fibers and extension.
 - Utilize the atlas, fig 262, 263 and 269.
 - Do the movements provided by these and explain the action of each muscle precisely.
6. Identify in the anatomical pieces the muscles of the deep group of the thorax, mainly the external and internal intercostals, and describe its particular characteristics.
 - To study the particular characteristics, it is necessary to distinguish the area of localization in the intercostals space and the direction of the fibers,
 - Utilize the atlas, fig. 258, 266 and 272.
 - Do the respiratory movements and explain how these muscles do this action.
7. Identify the visible muscles of the back and thorax on the body surface:
 - * The trapezius and latissimus dorsi muscles on the back. The last one forming the posterior fold of the axilla.
 - * Triangle of auscultation: bounded medially by the lateral border of trapezius, laterally by the medial border of the scapula and below by the upper border of latissimus dorsi.
 - * The pectoral major forming the anterior fold of the axilla.
 - * Infraclavicular fossa.
 - * Digitations of serratus anterior on the lateral wall of thorax.

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Bibliography:

- Cunniggham's textbook of Anatomy. 12th edition. Pages 277 to 281, 310 to 318 and 349 to 352.
- Sobotta/figge. Atlas of Human Anatomy. Vol 1. Pages 141 to 162.
- You may use the "Learning guide to Practical Anatomy I" (booklet). Pages 11, 12 and 29.

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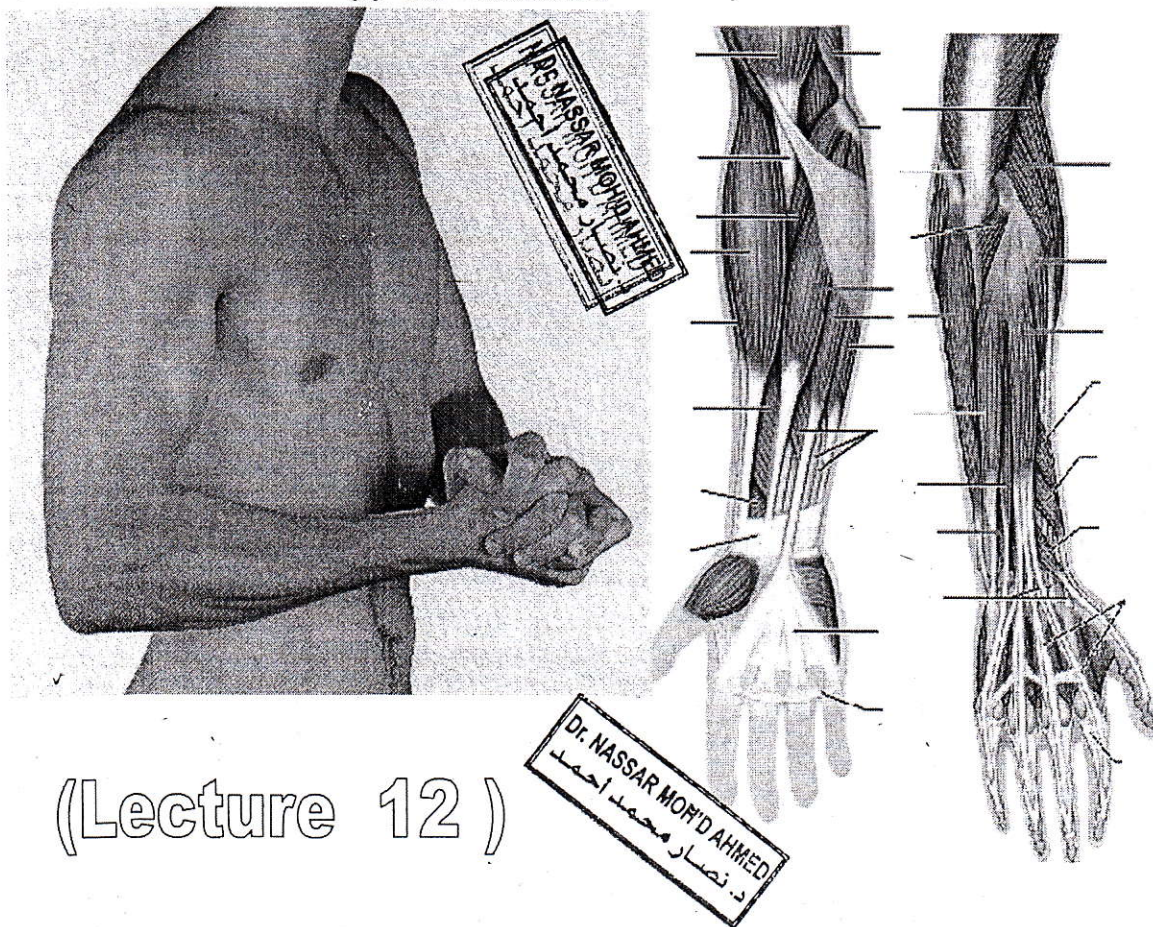
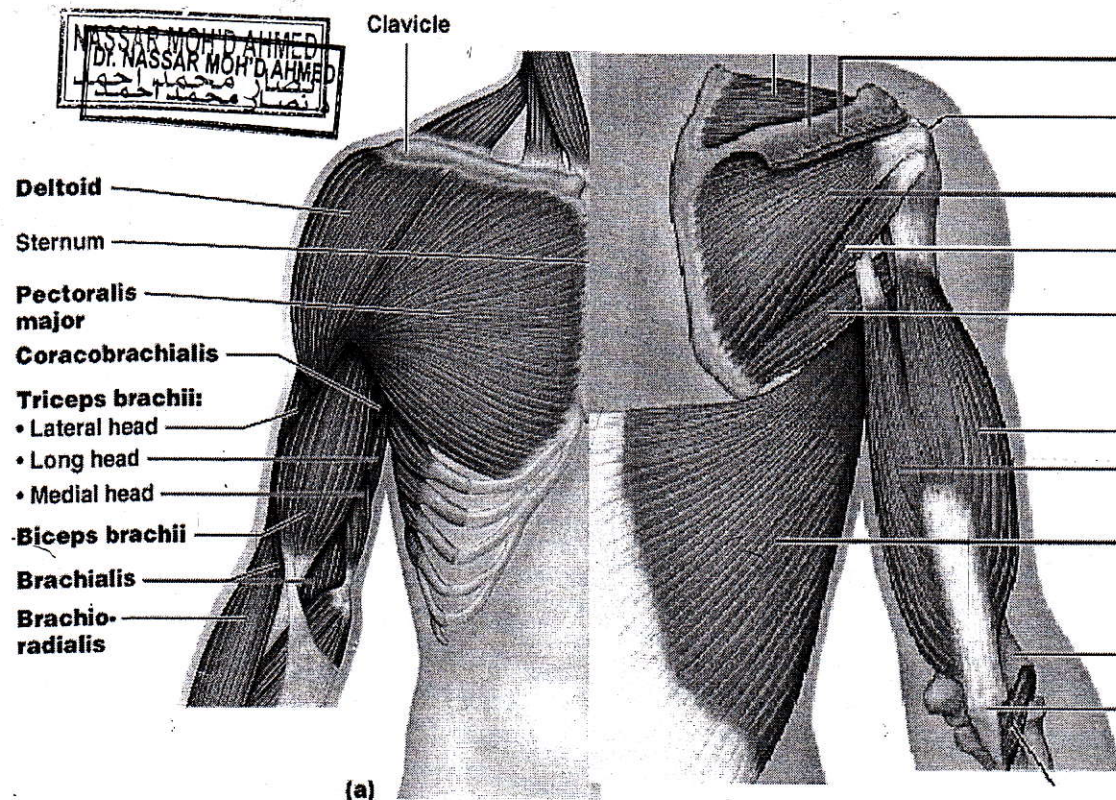
- SELF ASSASMENT

- 1- Give the name of the muscles that can make Inspiration.
- 2- Name the muscles that help in Expiration.
- 3- Write muscles make rotation of upper limb at shoulder joint.
- 4- Muscles that flex, and extend the shoulder joint.

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DEPARTMENT OF MORPHOLOGICAL SCIENCES
HUMAN ANATOMY I FOR MEDICAL STUDENTS

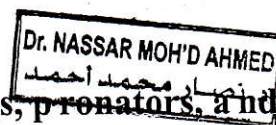


(Lecture 12)

MUSCLES OF UPPER LIMB

GENERAL CHARACTERISTICS OF MUSCLES OF UPPER LIMB

- The muscles of the upper limb are grouped according to their anatomical situation:
 1. Scapulo-humeral muscles
 2. Muscles of the arm.
 3. Muscles of the forearm
 4. Muscles of the hand
- Usually, the muscles of each region cross the joint between the bone(s) of the region they are placed in, and the bones of the next region (distal to it), thus; they move mainly that next (distal) region. Example: brachialis muscle is a muscle of the **arm** and its functions are flexion and pronation of the **forearm**. Such a situation occurs when the muscle is one-articular, i.e., it crosses only **one** joint.
- Some muscles are BI (2) or MULTI-articular, i.e., they cross more than one joint, thus moving two or more regions of the upper limb. Example: biceps brachii muscle flexes the arm at the shoulder joint, and flexes and supinates the forearm at the elbow joint.
- The muscles crossing joint(s) anteriorly are **flexors, pronators, and medial rotators** (with some exceptions).
- The muscles crossing joint(s) posteriorly are **extensor, supinators, and lateral rotators** (with some exceptions).



SCAPULO-HUMERAL MUSCLES

They are a group of muscles that connect the scapula to the humerus, crossing the shoulder (gleno-humeral) joint at various sides. Their actions depend upon their anatomical relations to the shoulder joint.

1. **Deltoid muscle:** multipennate, fan-shaped muscle, covering and forming the bulging contour of the shoulder.

Origin: described into three parts:

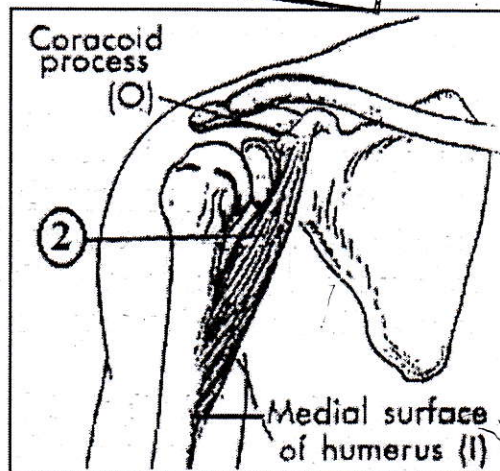
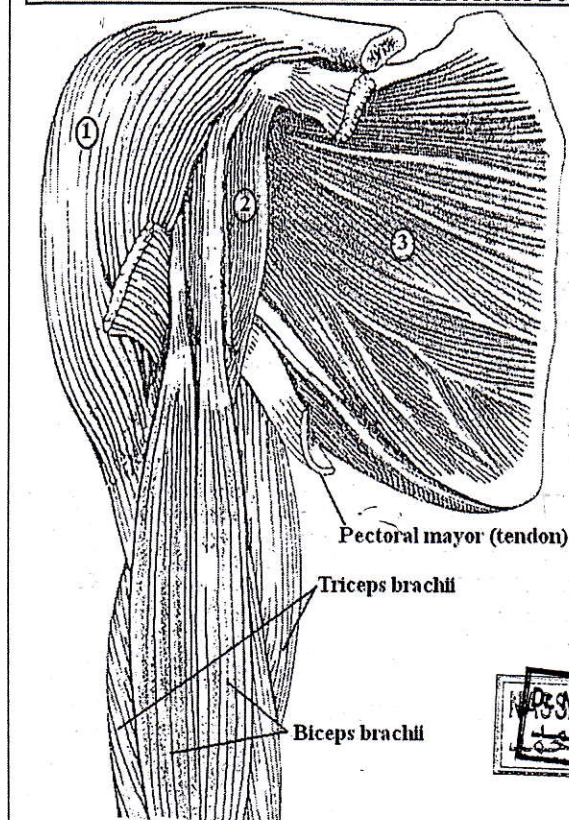
- a) **Clavicular** (anterior fibers) → lateral third clavicle
- b) **Acromial** (middle fibers) → acromion of scapula.
- c) **Scapular** (posterior fibers) → inferior border of the spine of the scapula.

Insertion: deltoid tuberosity of the humerus.

Actions:

- Abduction of arm.
- Anterior fibers are flexors and medial rotators of the arm.
- Posterior fibers are extensors and lateral rotators of the arm.

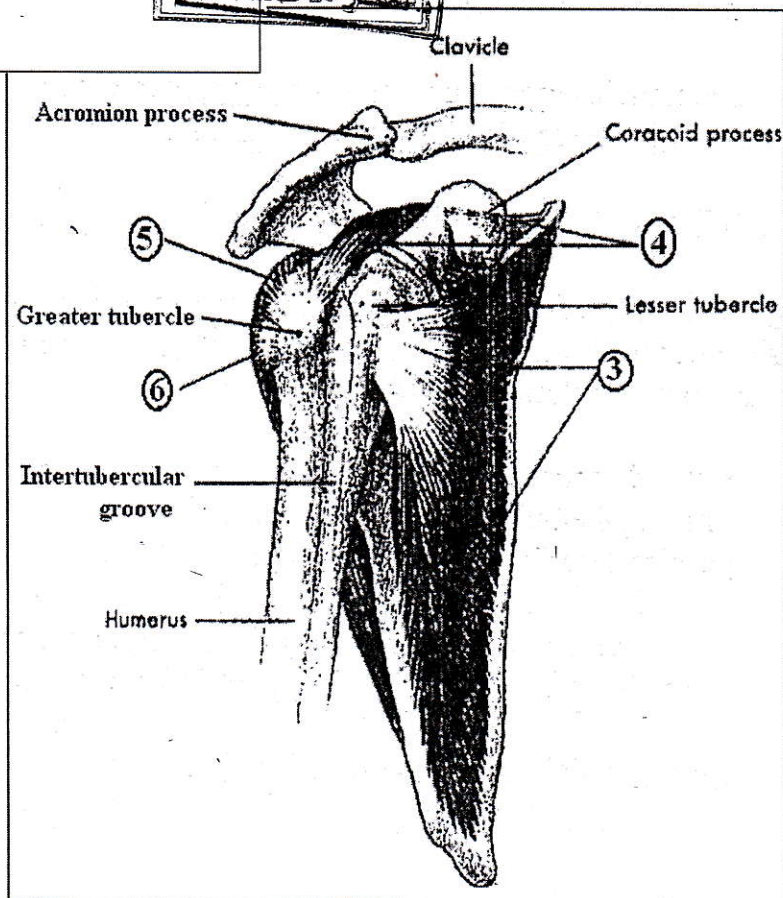
SCAPULO-HUMERAL MUSCLES: ANTERIOR ASPECT



→ See brachialis muscle below biceps brachialis.

NOTE!

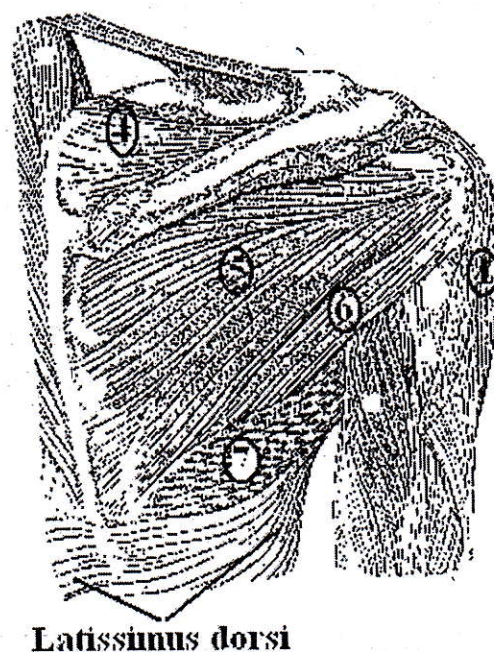
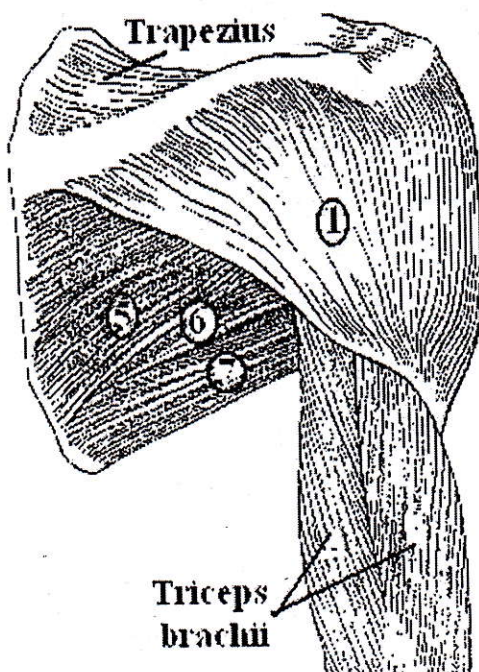
Tendons of the teres minor (6), infraspinatus (5), supraspinatus (4) and subscapularis (3) muscles surrounding the head of the humerus. That's why they are called 'rotator cuff muscles'.



	Muscle	Origin	Insertion	Actions
Anterior sub-group				
2	Coracobrachialis	Scapula (coracoid process)	Humerus (middle third of medial side)	-Adduction arm -Assists in flexion and medial rotation of arm
3	Subscapularis	Scapula (subscapular fossa)	Humerus (lesser tubercle)	Medial rotation arm.
Posterior sub-group				
4	Supraspinatus	Scapula (supraspinous fossa)	Humerus (greater tubercle)	-Assisting in abducting arm.
5	Infraspinatus	Scapula (infraspinatus fossa)	Humerus (greater tubercle)	Lateral rotation arm.
6	Teres minor	Scapula (axillary border)	Humerus (greater tubercle)	-Adduction and -Lateral rotation arm.
7	Teres major	Scapula (lower angle)	Humerus (medial lip of intertubercular sulcus)	Assists in: -Extension, -Adduction and -Medial rotation of arm.



ESCAPULO-HUMERAL MUSCLES: POSTERIOR ASPECT



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MUSCLES OF THE ARM

They are arranged into two groups, according to their location in the arm, and their actions (mainly on the forearm)

- I. Anterior → Flexor group
- II. Posterior → Extensor group

I. Anterior muscles of the arm

1. **Biceps brachii muscle:** it is a fusiform, bicipital and biarticular muscle.

Origin: by two heads:

- a) **Long head** → supraglenoid tubercle of the scapula. The tendon lies in the intertubercular groove of humerus.
- b) **Short head** → coracoid process of scapula.

Insertion: also by two attachment:

- a) **Tendon** → tuberosity of radius.
- b) **Bicipital aponeurosis** → medial side of the fascia of forearm.

Actions:

- Flexor and supinator of forearm at the elbow joint.
- Flexor of the arm at the shoulder joint (anteflexion).

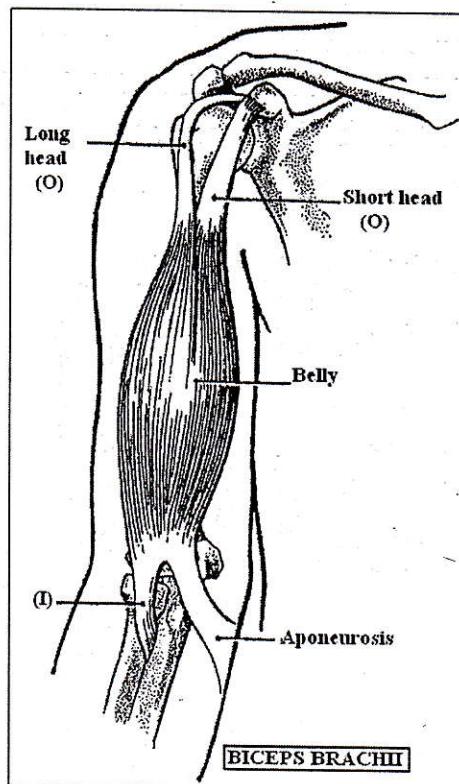
2. **Brachialis muscle:** situated beneath biceps brachialis muscle, in front of the elbow joint.

Origin: anterior surface distal half of humerus (shaft).

Insertion: coronoid process of ulna.

Action: main flexor of the forearm at the elbow joint.

3. **Coracobrachialis muscle:** consider mainly one of the scapulo-humeral muscles. See its description in the previous page.



II. Posterior muscles of the arm

1. Triceps brachii muscle: is a tricipital, biarticular muscle.

Origin: by three heads:

Long head → infraglenoid tubercle of scapula.

Lateral head → posterior surface shaft of humerus above radial groove.

Medial head → posterior surface shaft of humerus below radial groove.

Insertion: olecranon of ulna.

Actions:

Extensor of the forearm at the elbow joint.

Extensor (retroflexion) of arm at shoulder joint.



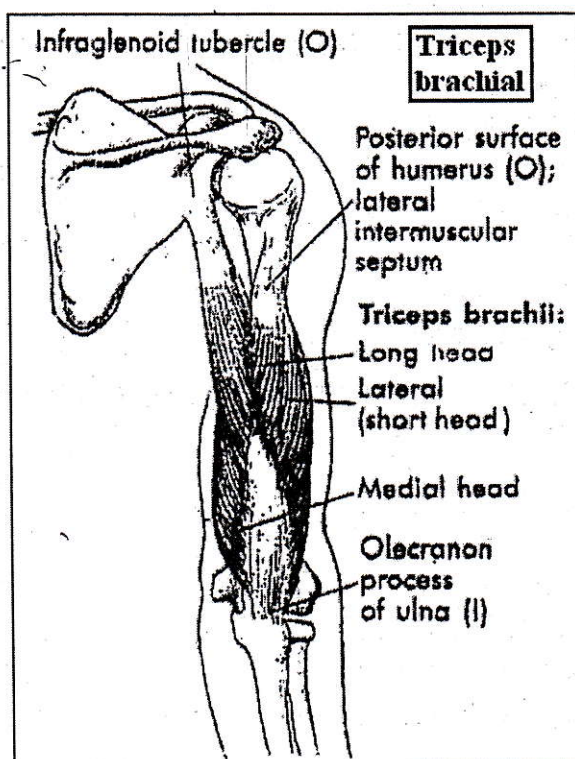
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2. Anconeus muscle:
small, triangular muscle,
situated superficially at the
posterior-lateral aspect of
the elbow.

Origin: lateral
epicondyle of
humerus.

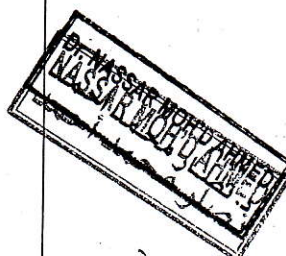
Insertion: lateral
side of olecranon and
upper part of ulna.

Action: weak
extensor of forearm at
elbow joint.



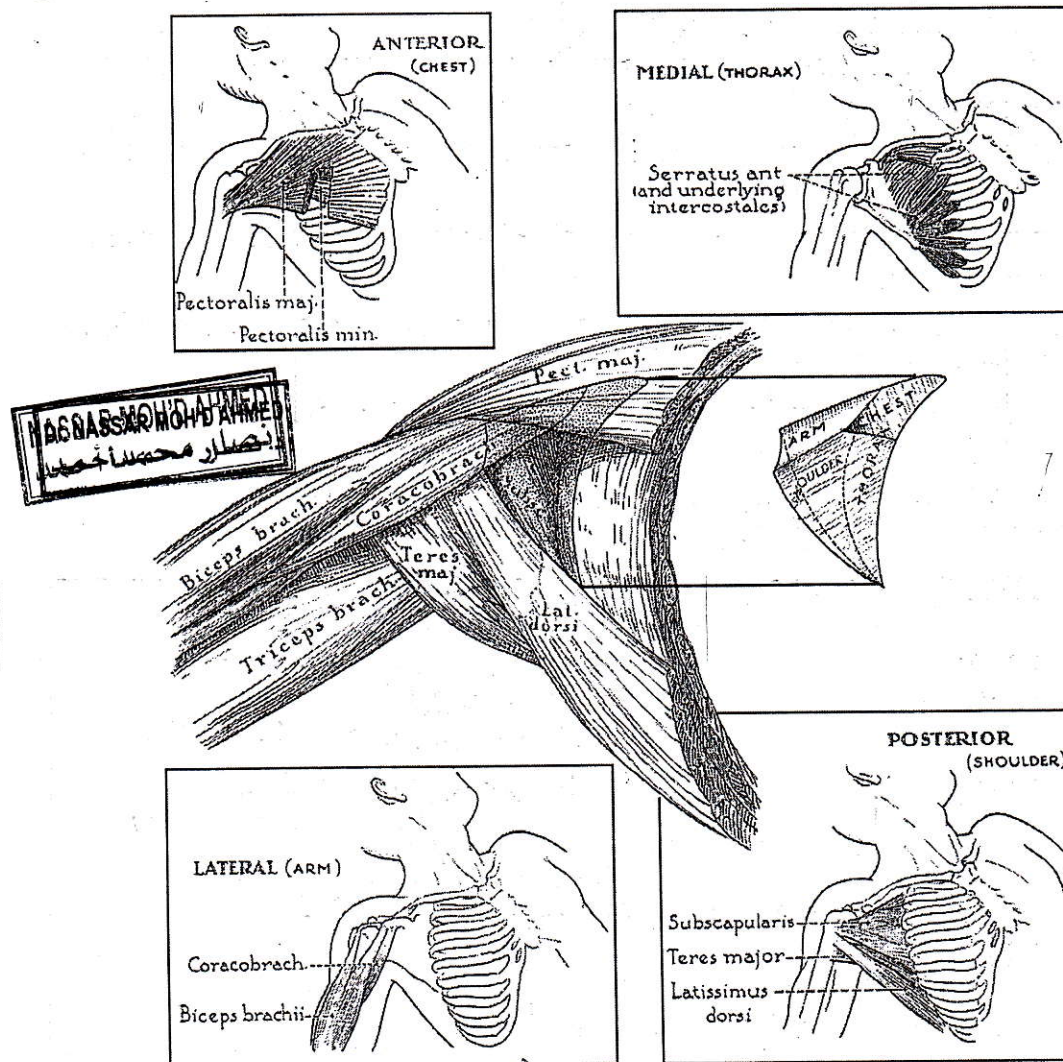
SUMMARY OF MUSCLES THAT ACT ON THE ARM AND FOREARM AT THE SHOULDER AND ELBOW JOINTS.

Muscles acting at shoulder (glenohumeral) joint	Muscles acting at elbow joint
1. Flexors of arm (anteflexion): a) Pectoralis major. b) Anterior fibers of deltoid. c) Coracobrachialis d) Biceps brachii 2. Extensors of arm (retroflexion): a) Triceps brachii b) Teres major c) Latissimus dorsi d) Posterior fibers of deltoid. 3. Abductors of arm: a) Deltoid b) Supraspinatus 4. Adductors of arm: a) Pectoralis major b) Latissimus dorsi c) Teres major d) Teres minor e) Coracobrachialis 5. Lateral rotators arm a) Infraspinatus b) Teres minor c) Posterior fibers of deltoid. 6. Medial rotators arm: a) Pectoralis major b) Latissimus dorsi c) Subscapularis d) Teres major e) Coracobrachialis f) Anterior fibers of deltoid	1. Flexors of forearm: a) Biceps brachii b) Brachialis c) Brachioradialis 2. Extensors of forearm: a) Triceps brachii b) Anconeus 3. Supinators of forearm: a) Supinator muscle b) Biceps brachii 4. Pronators of the forearm: a) Pronator teres b) Pronator quadratus



SURFACE ANATOMY

AXILLA: AXILLARY FOSSA or SPACE



Boundaries:

Anterior wall → the pectoral^{major} muscles.

Posterior wall → the subscapularis, teres major and latissimus dorsi muscles.

Medial wall → the upper ribs covered by the serratus anterior muscle.

Lateral wall → the humerus with the biceps and the coracobrachialis muscles.

The floor → is the axillary fascia formed by the extension of the pectoral fascia from the anterior to the posterior.

Contents: the axillary vessels and cords of the brachial plexus enclosed within the fascial sheath, branches and lymph nodes.

MUSCLES OF THE FOREARM

Common characteristics:

- They are arranged into two groups according to their anatomical position (and function): **anterior (flexor) group** and **posterior (extensor) group**.
- The two groups are separated by the posterior (subcutaneous) border of the ulna.
- The muscles of each group are organized into two layers: **superficial** and **deep** layers.
- Most muscles of each layer start from a **common origin** (the insertions are described individually).
- Most muscles are named according to the main action performed.

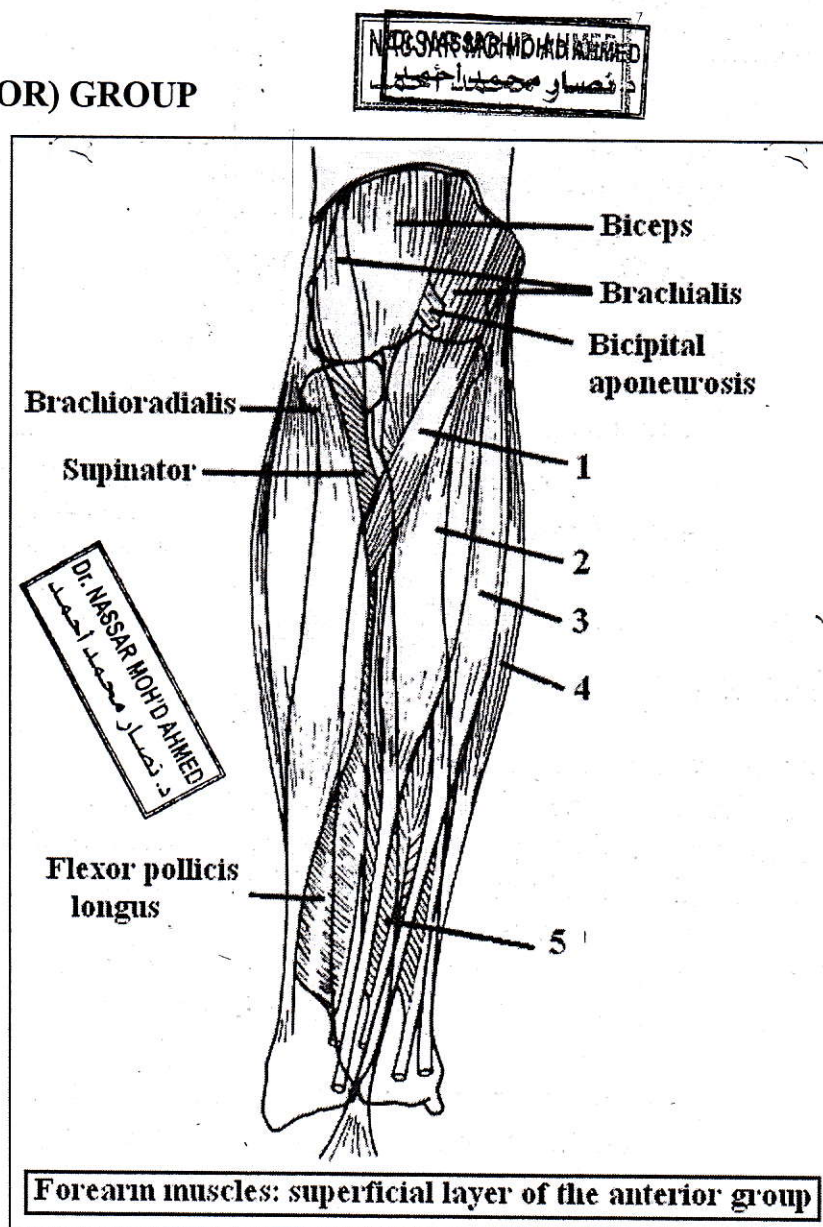
ANTERIOR (FLEXOR) GROUP

Superficial layer:

1. Pronator teres
2. Flexor carpi-radialis
3. Palmaris longus.
4. Flexor carpi-ulnari
5. Flexor digitorum superficialis

Deep layer:

6. Flexor digitorum profundus
7. Flexor pollicis longus
8. Pronator quadratus



COMMON ORIGIN of **superficial layer**: Medial epicondyle of humerus.

COMMON ORIGIN of **deep layer**: Anterior surfaces of radius and ulna bones and interosseus membrane, **except 8**.

INSERTION can be summarized in this way:

- Bases of the metacarpal bones (2 & 4)
 - Bases of the **middle** phalanges of the 2nd to the 5th fingers (5)
 - Bases of **distal** phalanges of: thumb (7) & from 2nd to 5th fingers (6)
 - Palmar aponeurosis (3), diaphysis of radius (1) & pisiform bone (4).
- Most of their tendons pass through the **carpal canal** (see page 8, lecture 7)

MAKE YOUR OWN TABLE GIVING THE INSERTION FOR EACH MUSCLES YOU WILL ASKED ABOUT IT

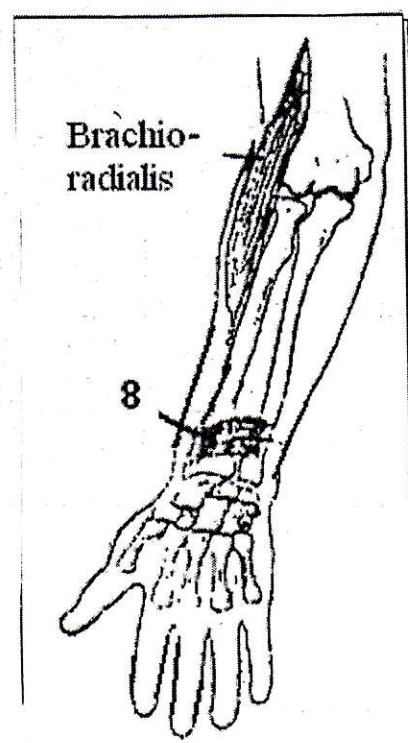
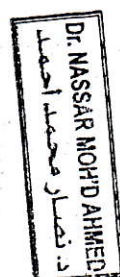
MAIN ACTIONS: **flexion of the hand** -at different joints- **and pronation of forearm**:

- Flexion of the hand at the wrist joint (2, 3, 4, 5 & 6).
- Flexion of metacarpo-phalangeal joints (3, 5 & 6)
- Flexion of the inter-phalangeal joints: # 5 flexes only the proximal; but # 6 flexes all of them. It means that **flexor digitorum profundus** is the only muscle capable of flexing the distal inter-phalangeal joints. And # 7 makes the flexion of all the phalanges of the **thumb**.
- Pronation of the forearm (1 & 8), due to its insertion and fibers-direction. E.g. 1 is extended from the medial epicondyle of humerus (origin) to the lateral surface of the body of radius (insertion) and 8 is a flat, quadrilateral muscle, extended obliquely between the anterior surfaces of the distal parts of ulna (origin) and radius bone (insertion).



Besides,

- **Abduction of the hand** at wrist joint (2, due to its lateral position)
- **Adduction of the hand** at wrist joint (4, due to its medial position)
- And # 3 makes anchorage of the fascia and skin of palm



SURFACE ANATOMY: ULNAR or CUBITAL FOSSA

It is the triangular space at the bend or fold of the elbow joint, which is the base of the triangle.

The **boundaries** are:

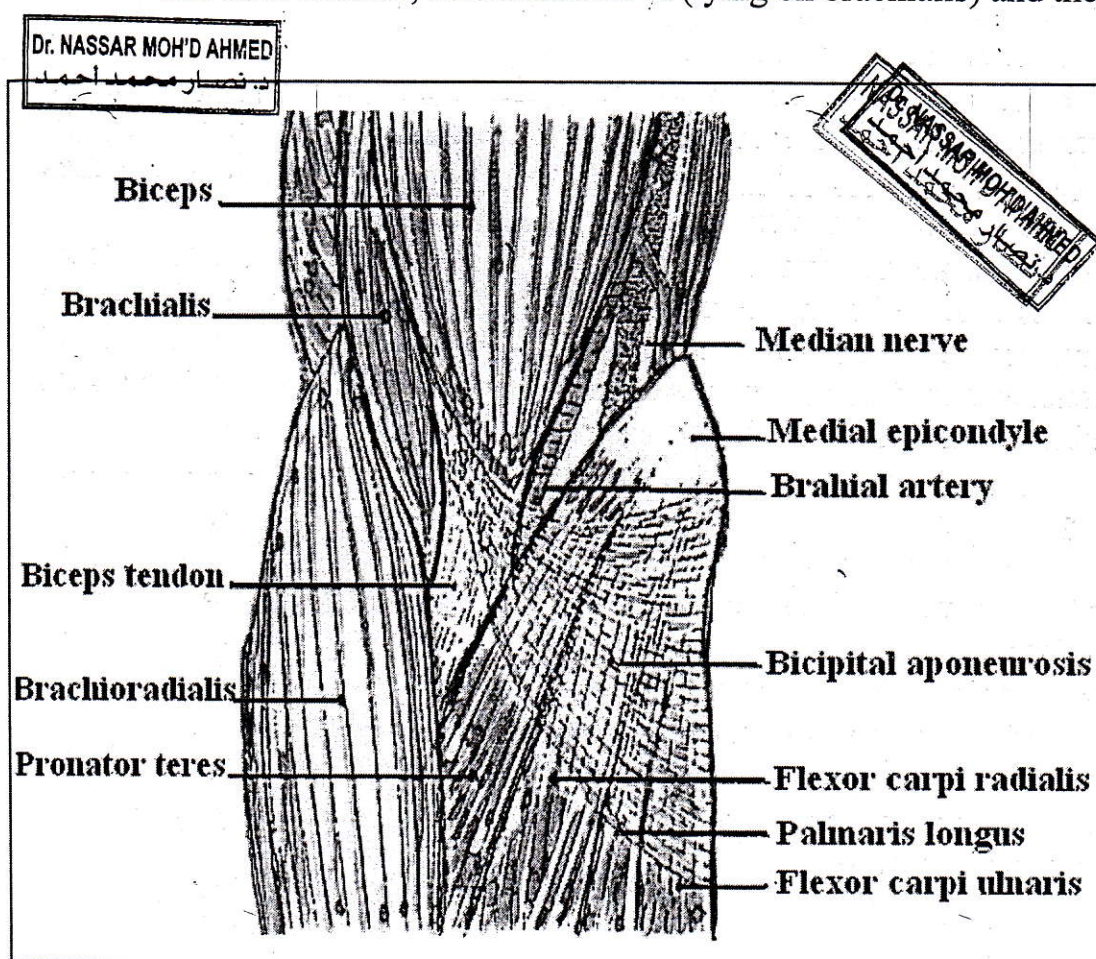
The apex → is formed distally by the brachioradialis and the pronator teres muscles.

The lateral side → the medial side of the brachioradialis muscle.

The medial side → the lateral side of the pronator teres muscle.

The floor → formed by the supinator muscle covering the radius and the brachialis covering the upper part of the ulna.

Contents: the tendon of the biceps, the brachial artery dividing into radial and ulnar arteries, the median nerve (lying on brachialis) and the



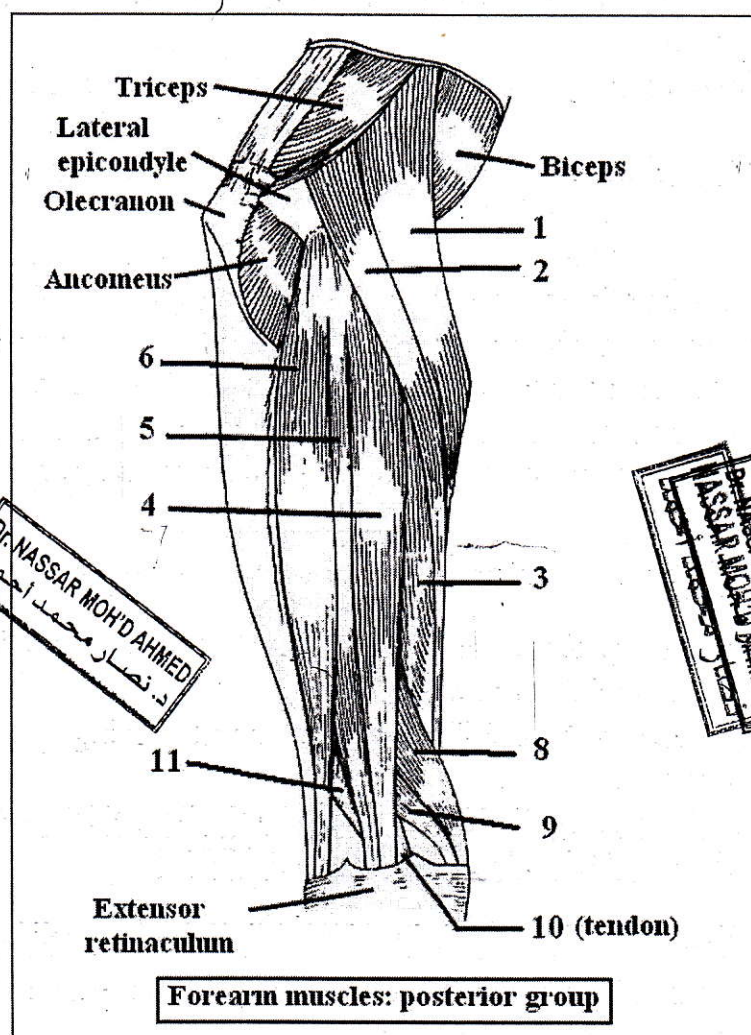
POSTERIOR (EXTENSOR) GROUP

Superficial layer

1. Brachioradialis Muscle (*)
2. Extensor carpi-radialis longus
3. Extensor carpi-radialis brevis
4. Extensor digitorum communis
5. Extensor digiti minimi
6. Extensor carpi-ulnaris

Deep layer

7. Supinator muscle
8. Abductor pollicis longus
9. Extensor pollicis brevis
10. Extensor pollicis longus
11. Extensor indicis



(*) This muscle may be described in the anterior group of the arm because of its function as *flexor of forearm at elbow joint* and its origin above lateral epicondyle of humerus, but it is nerve supplied by the radial nerve like all posterior (extensor) muscles of the upper limb.

COMMON ORIGIN of *superficial layer*: Lateral epicondyle of humerus.

COMMON ORIGIN of the *deep layer*: Posterior surface of radius and ulna bones and interosseous membrane.

INSERTION (in summarized way) in the dorsal surface of:

- Bases of metacarpal bones of: 1st (8), 2nd & 3rd (2 & 3) and 5th (6)
- Bases of the distal phalanges of: thumb (10) & the 2nd to the 5th fingers (4).
- Bases proximal phalanges of: thumb (9), index finger (11), and the little finger (5).
- Moreover: in the styloid process of radius in case of # 1.

- Bases of the distal phalanges of: thumb (10) & the 2nd to the 5th fingers (4).
- Bases proximal phalanges of: thumb (9), index finger (11), and the little finger (5).
- Moreover: in the styloid process of radius in case of # 1.

MAIN ACTIONS: *extension of the hand -at different joints- and supination of forearm:*

- Extension of the hand at the wrist joint (2, 3, 4, 5, 6).
- Extension of metacarpo-phalangeal joints ()
- Extension of the inter-phalangeal joints: # 4 extends all of them, # 5 extends the little finger, # 9 & 10 extend **thumb** and # 11 extends index.
- Supination of the forearm (7), because it is extended between ulna and radius in a spiral way, very deep, in the proximal part of the forearm.

Besides,

- ***Abduction of the hand*** at wrist joint (2, 3, 8, 9 & 10) due to its lateral position)
- ***Adduction of the hand*** at wrist joint (6. due to its medial position)
- ***Abduction of the thumb*** (8).
- And also # 1 stabilizes elbow joint during rapid flexion-extension movements.

MAKE YOUR OWN TABLE GIVING THE INSERTION FOR EACH MUSCLES YOU WILL ASKED ABOUT IT

SOMETHING IMPORTANT ABOUT SURFACE ANATOMY

- Between the tendon of **brachioradialis muscle** and the tendon of the **flexor carpi radialis** is the place to feel the radial pulse.

SNUF BOX

It is the triangular space at the lateral side of the dorsum of hand, just distal to the radial styloid process.

The **boundaries** are:

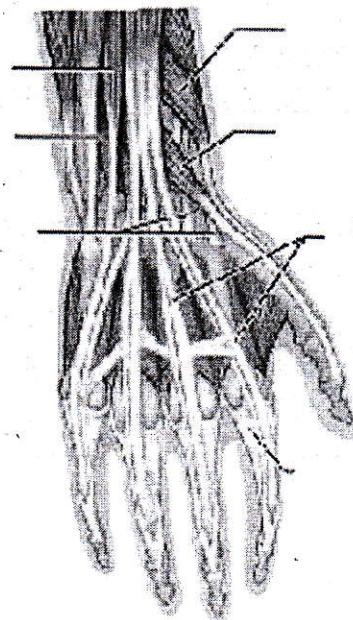
The lateral side → tendons of abductor pollicis brevis & extensor pollicis brevis

The medial side → tendon of extensor pollicis longus

The apex → distal end of radius, upwards

The floor → scaphoid bone

Content: the radial artery & the branches of the superficial radial nerve lie here.



SUMMARY OF MUSCLES OF FOREARM ACCORDING TO ACTIONS

1. Muscles rotating the forearm at radioulnar joints:

- Pronator teres
- Supinator
- Pronator quadratus
- Biceps brachii

2. Flexors of hand at wrist joint:

- Flexor carpi-radialis
- Flexor carpi-ulnaris
- Flexor digitorum superficialis
- Flexor digitorum profundus
- Palmaris longus

3. Extensors of hand at wrist joint:

- Extensor carpi-radialis longus
- Extensor carpi-radialis brevis
- Extensor carpi-ulnaris
- Extensor digitorum (common)
- Extensor digiti minimi
- Extensor pollicis longus

4. Flexors of the fingers:

- Flexor digitorum superficialis
- Flexor digitorum profundus
- Flexor pollicis longus
- Palmaris longus

5. Extensors of the fingers:

- Extensor digitorum (common)
- Extensor indicis
- Extensor pollicis longus
- Extensor pollicis brevis
- Extensor digiti minimi

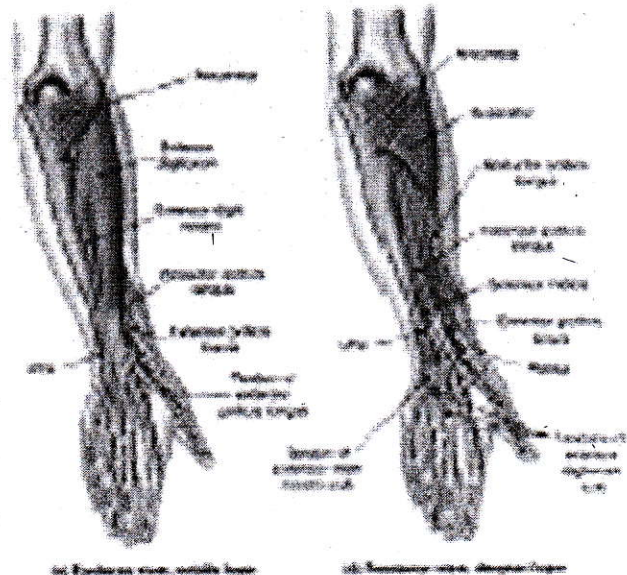
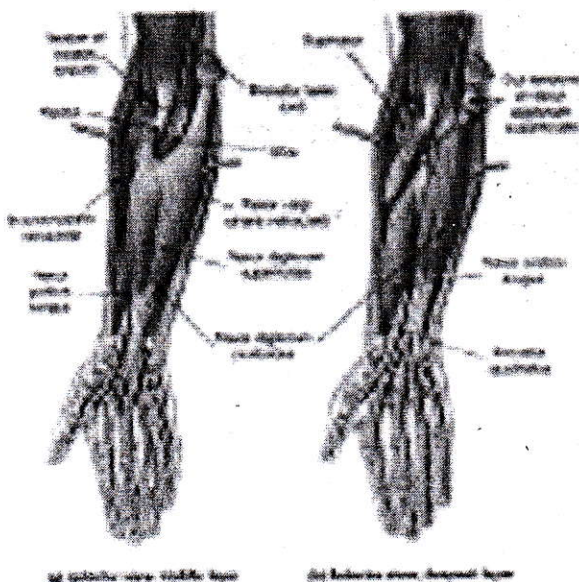
6. Abductors of hand at wrist joint:

- Extensor carpi-radialis longus
- Extensor carpi-radialis brevis
- Flexor carpi-radialis
- Extensor pollicis longus
- Extensor pollicis brevis
- Abductor pollicis longus

7. Adductors of hand at wrist joint:

- Flexor carpi-ulnaris
- Extensor carpi-ulnaris

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MUSCLES OF THE HAND

They are a number of short, intrinsic muscles performing fine movements of the fingers.

There are various ways of classification of the muscle of the hand. We will follow that which divides the muscles into three groups:

- A. **Muscles of thenar eminence:** situated at the radial side of the palm, related to the movements of the thumb.
- B. **Muscles of hypothenar eminence:** situated at the ulnar side of the palm, related to the movements of the little finger.
- C. **Central muscles of the hand:** situated between metacarpal bones, related to several movements of the fingers in general.

A. Muscles of thenar eminence:

1. Abductor pollicis brevis.
2. Flexor pollicis brevis.
3. Adductor pollicis.
4. Opponens pollicis (beneath abductor pollicis brevis)



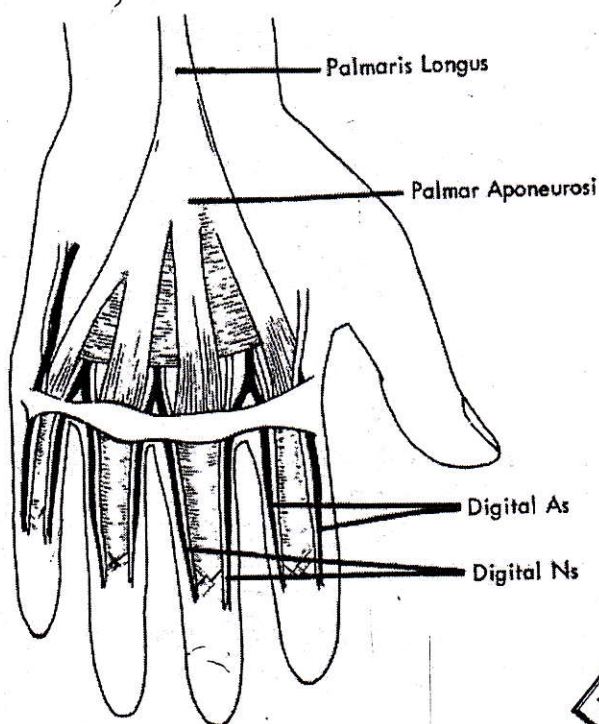
B. Muscles of hypothenar eminence:

1. Abductor digiti minimi.
2. Flexor digiti minimi.
3. Opponens digiti minimi (beneath the other two).
4. Palmaris brevis. (subcutaneous muscle).

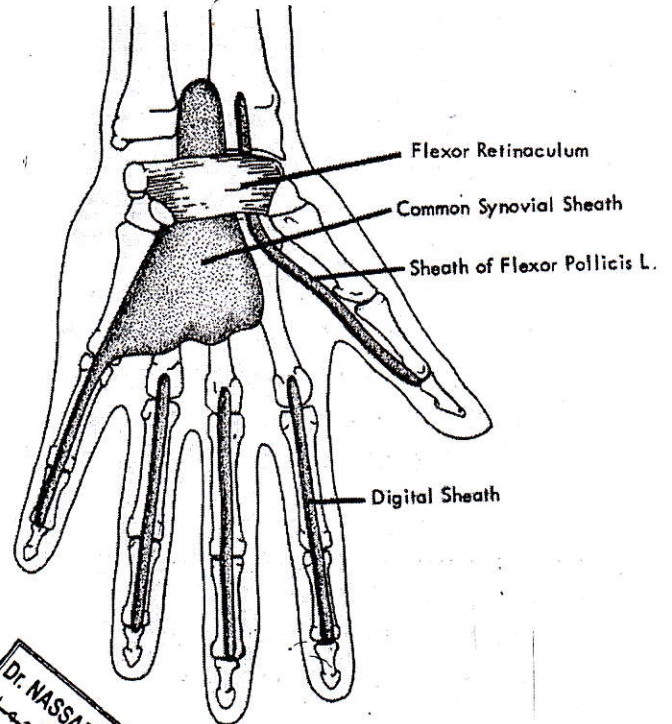


C. Central muscles of the hand:

1. Lumbrical muscles: flex metacarpo-phalangeal joints and extend interphalangeal joints (it means: to put the fingers in writing position).
2. Interosseous muscles: extend the inter-phalangeal joints and allow the adduction and abduction movements of the fingers II-V.
 - a) Palmar (volar) interossei: adduct the index, the ring finger and the little finger towards the middle finger.
 - b) Dorsal interossei: abduct the middle three fingers.

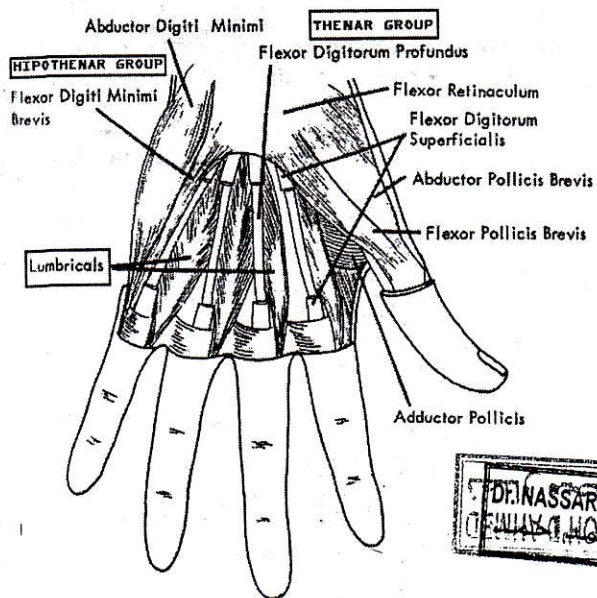


Palmar Aponeurosis and Fibrous Sheaths of Flexor tendons

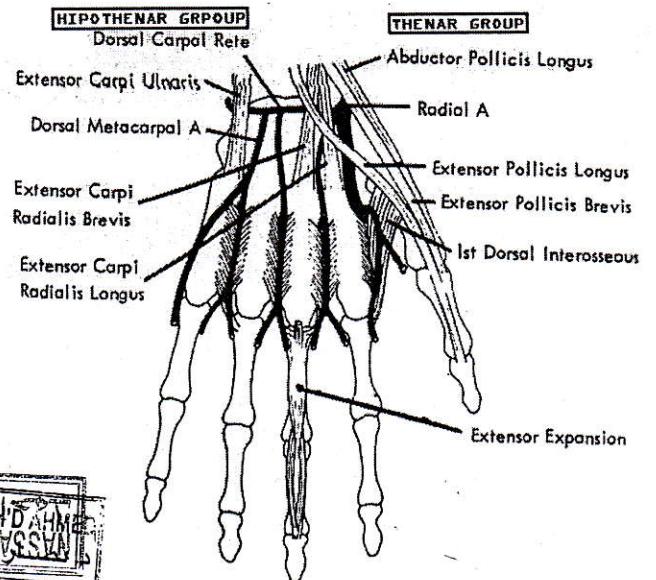


Flexor Synovial Sheaths

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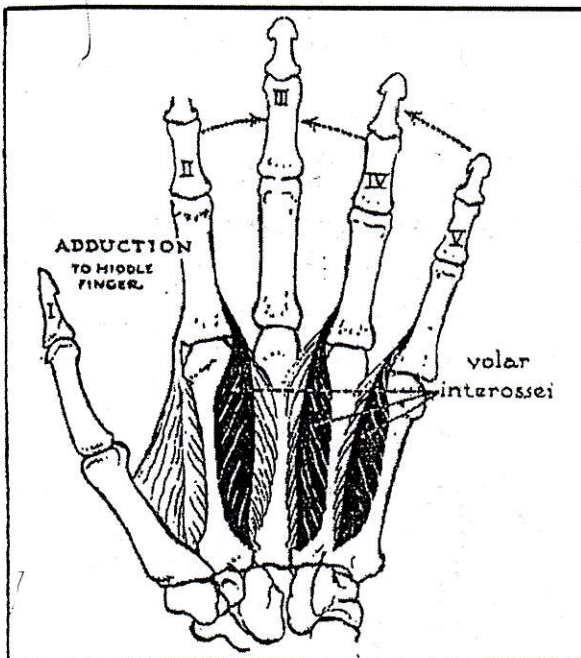
PALMAR MUSCLES: SUPERFICIAL LAYER



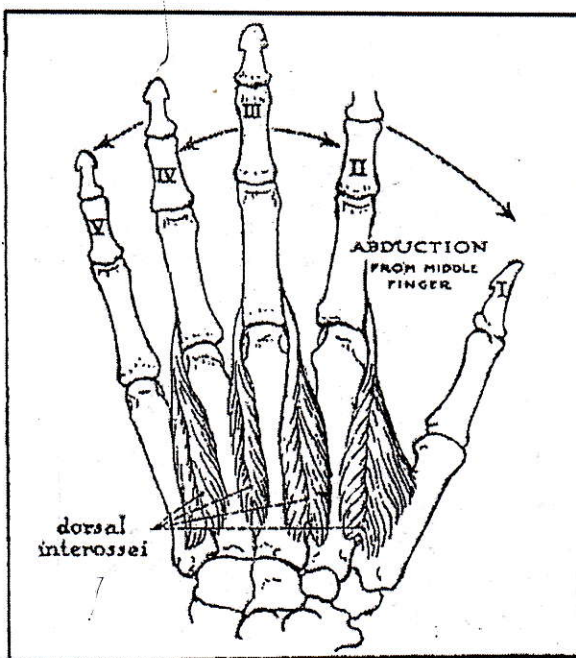
MUSCLES, TENDONS AND ARTERIES OF THE HAND
POSTERIOR ASPECT

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ANALYZE CAREFULLY THESE PICTURE ABOUT THE CENTRAL MUSCLES OF THE HAND



The three palmar interossei muscles
They adduct to the middle finger.



The four dorsal interossei muscles
They abduct from the 'line' of the middle finger.

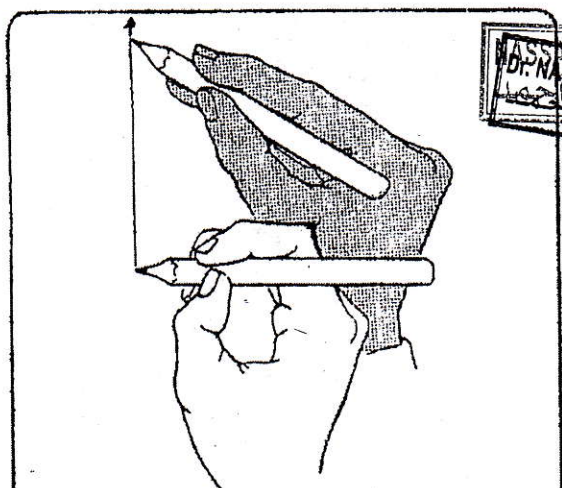
—Action

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1. Both palmar and dorsal interossei have a common function : they help the lumbricals in "putting the fingers in the writing position" i.e. they (a) flex the metacarpophalangeal joints and (b) extend the interphalangeal joints.

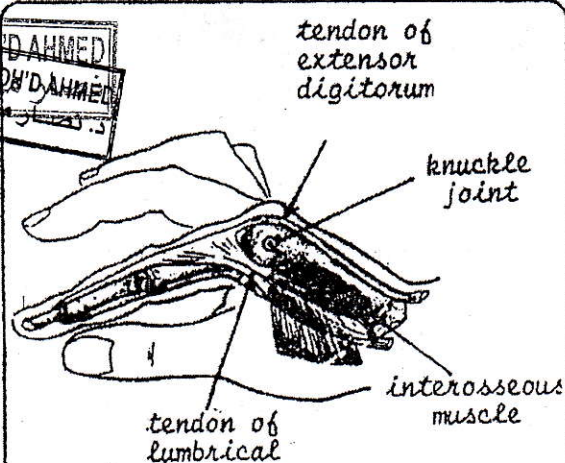
2. The palmar interossei : adduct the index, the ring finger and the little finger (towards the middle finger)

3. The dorsal interossei abduct the middle 3 fingers (from the «line of» the middle finger)

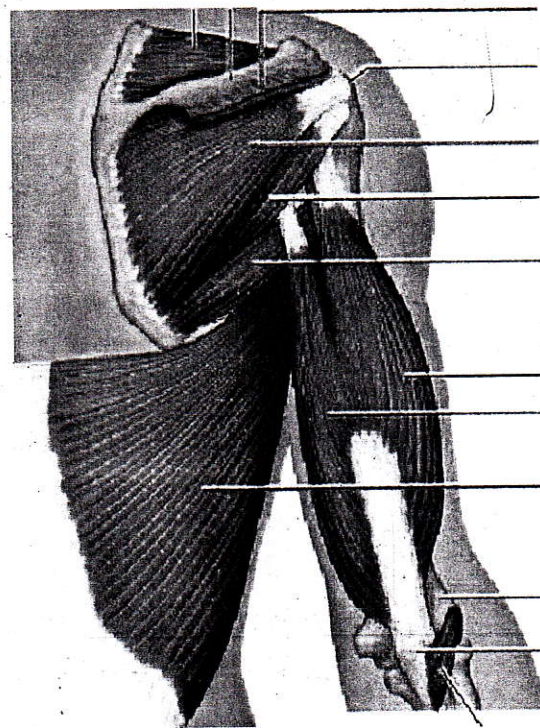
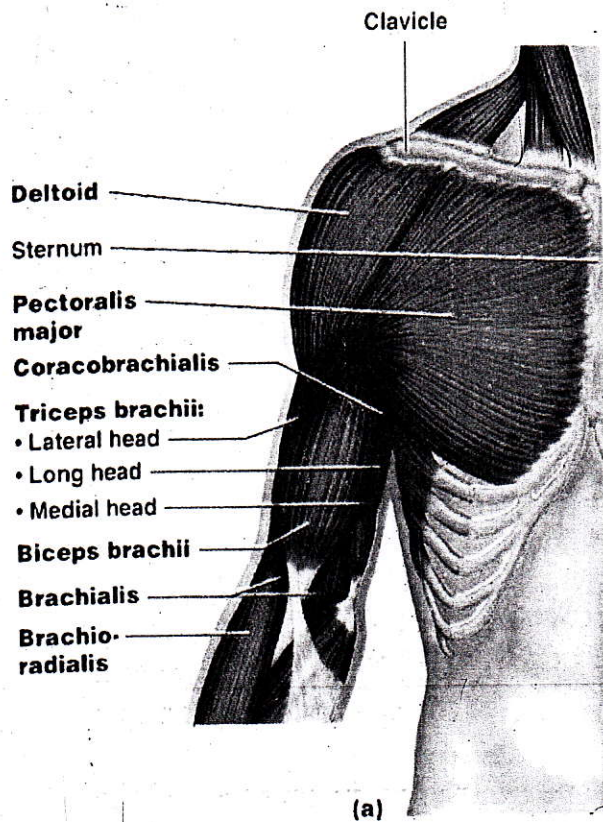


The position of the hand in the upper part of the figure is the result of action of both lumbricals and interossei.

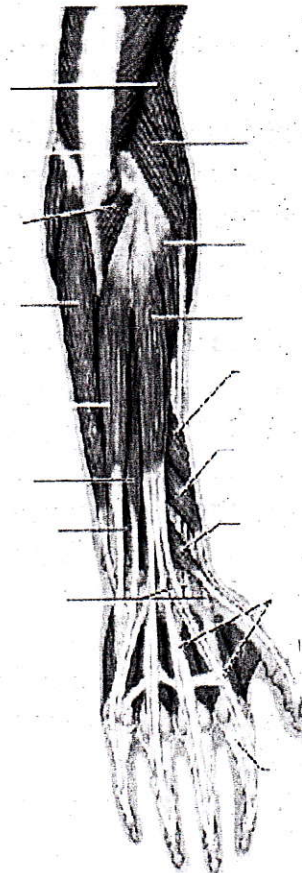
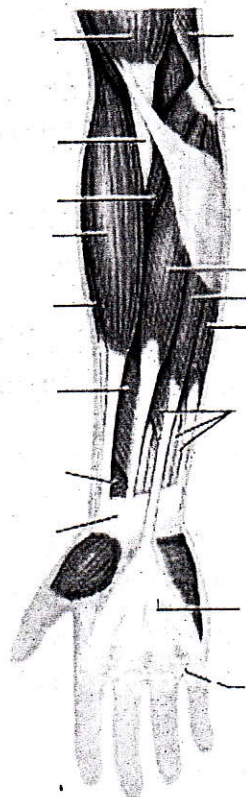
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The lumbricals and interossei
(a) flex the metacarpophalangeal joints &
(b) extend the interphalangeal joints
[proximal & distal]



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GUIDE FOR PRACTICAL CLASS # 9

Theme: MUSCLES OF THE UPPER LIMB

Summary: 1. Description of the muscles groups.

- Deltoid region.
- Arm muscles.
- Forearm muscles.
- Hand muscles as a whole.

2. Surface anatomy of these muscle groups.

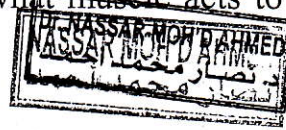
Objectives:

1. To classify the muscle groups of the upper limb, explaining its general characteristics and indicating them in the dissected cadaver or anatomical model.
2. To identify in the anatomical pieces or model the main muscles of the upper limb and characterizing their actions.
3. To identify on the skin surface of the upper limb, the most distinct relevant muscles.

Methodological orientations (TASKS)

1. Identify in the dissected cadaver or anatomical model **the muscles of the deltoid region** and describe the general and particular characteristics of each one of these muscles.
 - The coracobrachialis muscle may be included in the anterior group of arm as planified in the atlas.
 - Make an illustrated table or summary.
 - In order to analyze the muscular action of each muscle, it is important to observe the direction of the muscular fibers, the extension and the joint at which the muscle act.
 - Do the movement expected and explain what muscle acts to produce each type of movement.
 - Utilize the Atlas
2. Identify in the anatomical pieces or model **the muscles of the arm region** and describe the general and particular characteristics of each one of these muscles.
 - Make an illustrated table or summary.

- In order to analyze the muscular action of each muscle, it is important to observe the direction of the muscular fibers, the extension and the joint at which the muscle act.
- Do the movement expected and explain what muscle acts to produce each type of movement.
- Utilize the Atlas, figures 290 to 300.



3. Show in the dissected cadaver the **muscle groups of the forearm and the hand** and describe its general characteristics.

- Point out the disposition of the forearm muscles into a superficial and deep group and indicate them one in each group.
- Try to identify some of the superficial muscles in forearm.
- In order to analyze the action of the muscle groups it is necessary to observe the situation and extension of each muscle. Most of them are polyarticular.
- Utilize the Atlas, figures 301 to 304 and 316 to 320.
- Do the movements that take place in the hand and fingers and mention what group of muscles provides these movements.

4. **Surface anatomy:** identify the more notable outstanding muscles on the skin surface of the upper limb:

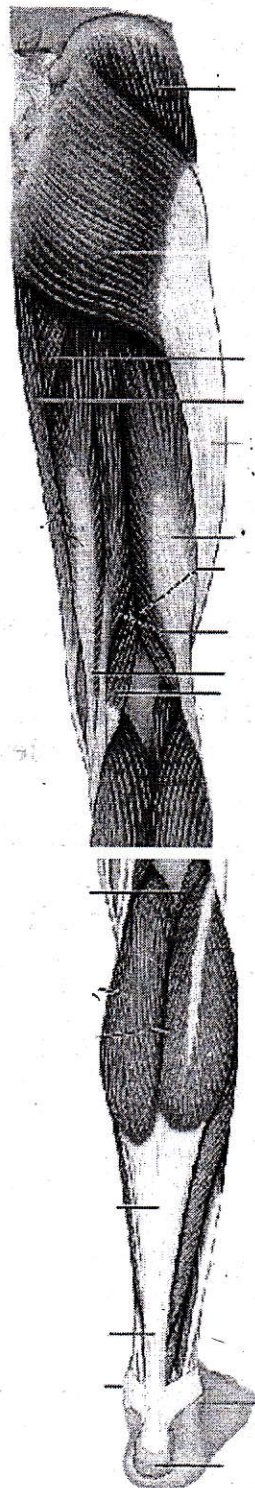
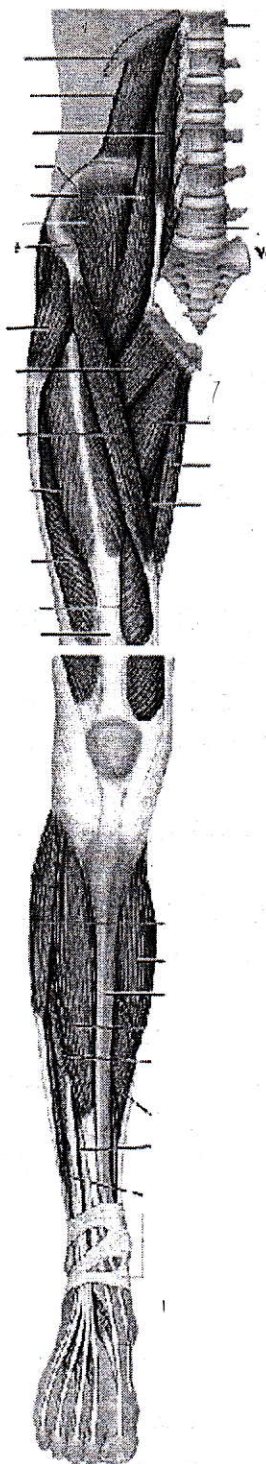
- Observe the contour of the shoulder formed by the deltoid muscle. Palpate in the posterior part of the **axilla** the relevant contracted teres major muscle.
- Flex the forearm and palpate the biceps brachii. Afterwards, extend it strongly and palpate the triceps brachii muscle.
- In the **cubital fossa**, palpate the first muscle of the anterior superficial group (pronator teres) and the primary muscle of the posterior superficial group (brachioradialis).
- In extension of finger, observe in the posterior part of the carpus a depression (anatomical snuff box) formed by the tendons of the abductor and extensor muscles of the thumb.
- Indicate the thenar and hypothenar region in the palmar surface of the hand.

Bibliography:



- Cunningham's textbook of Anatomy. 12th edition. Pages 318 to 224.
- Sobotta/figge. Atlas of Human Anatomy. Vol 1. Pages 190 to 166.
- You may use the Learning Guide of Practical Anatomy I' (booklet). Pages 35 to 34.

UNIVERSITY OF ADEN. FACULTY OF MEDICINE AND HEALTH SCIENCES
DEPARTMENT OF MORPHOLOGICAL SCIENCES)
HUMAN ANATOMY I FOR MEDICAL STUDENTS



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MUSCLES OF LOWER LIMB

(Lecture 13)

MUSCLES OF THE LOWER LIMB

The lower limb is built mainly for the support and locomotion (propulsion) of the human body, while the upper limb is able to perform fine and precise movements (hand) so, in comparison with the upper limb, the muscles of the lower limb are larger and stronger.

The muscles of the lower limb are described into four groups, according to their regional situation:

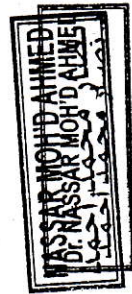
- I. Muscles of **the gluteal region** (buttock).
- II. Muscles of **the thigh**.
- III. Muscles of **the leg**.
- IV. Muscles of **the foot**.

The most powerful muscles of the lower limb are placed:

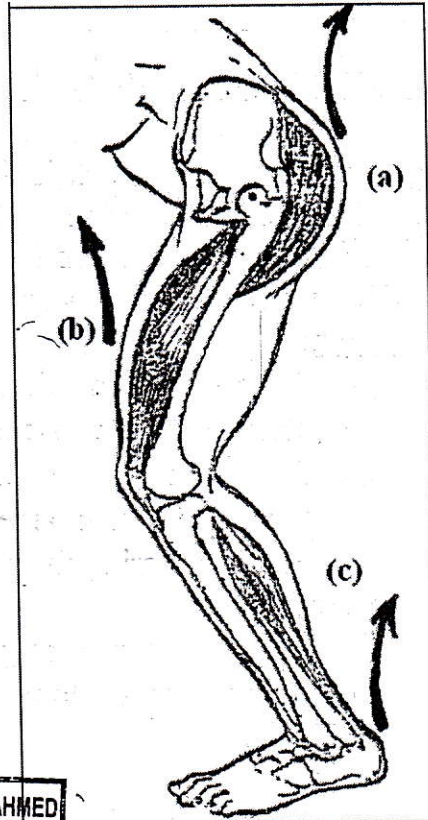
- a) At the back of the hip
- b) At the front of the thigh and
- c) At the back of the leg

And they perform an important roll:

- During walking
- In jumping
- As antigravity muscles: maintaining the erect posture against gravity.
- Helping to raise the body from the sitting to the standing position.

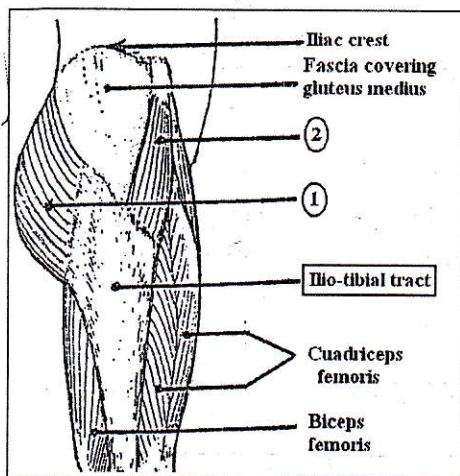


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As a general rule (like in the upper limb) the muscles of each region cross the corresponding joint to move the next region, e.g. the muscles of the leg cross the ankle joint and move the foot and toes. As an exception, most muscles of the thigh are **biarticular**, crossing the hip and the knee joints, then, they act both on the thigh and on the leg.

The musculature of the thigh is invested with a layer of the deep fascia called '**fascia lata**' (Lt. 'latum': wide). A lateral, thickened band of the fascia lata is called **iliotibial tract** extended from the tubercle of the iliac crest above to the lateral condyle of the tibia below.



Two gluteal muscles attach to the **iliotibial tract**:

1. **Gluteus maximus**
2. **Tensor fascia lata**

They use the **iliotibial tract** as common aponeurosis and by this way they act on the knee joint.

I. MUSCLES OF THE GLUTEAL REGION (BUTTOCK)

The gluteal region or buttock is the rounded prominent at both sides of the back of the pelvis, extended between the iliac crest above and the gluteal fold below (with separates it from the posterior compartment of the thigh).

1. **Gluteus maximus**: large muscular mass situated superficial at the buttock.

Origin:

- Posterior part of ilium.
- Thoracolumbar fascia.
- Dorsal surfaces sacrum and coccyx.
- Sacrotuberous ligament.
- Fascia covering the muscle.



Insertion:

- Deep fibers into the gluteal tuberosity of femur.
- Rest of fibers into the iliotibial tract which attaches to the tibia.

Actions:

- Extension and lateral rotation of the thigh at hip joint.
- Extension of the trunk on the lower limb.
- Extension of the flexed knee with the sole of the foot on the floor.

By these actions, the gluteus maximus muscle is of great importance for:

- Raising the body from a sitting squatted or stopped positions.
- Walking and running.
- Maintaining of the erect posture while standing.
- Climbing stairs.
- Jumping.



2. **Gluteus medius**: it is overlapped by the tensor fascia lata on its anterior part, and by gluteus maximus on its posterior part. Its middle part is covered by a strong fascia.

- Flexion, abduction and medial rotation of the femur at the hip joint.
- Tightening of the knee joint.

The abduction action on the thigh, and the action of the tightening the knee joint is of great importance during walking since they stabilize the pelvis over supporting limb together with the actions of gluteal muscles.

The following deep muscles of the gluteal region are situated beneath under cover of the gluteus maximus muscle. Their fibers run almost in a horizontal direction extended from the pelvic wall to the upper end of femur crossing the hip joint posteriorly. They act as **lateral rotators of the thigh at hip joint** but most probably their main action is as **extensile ligaments holding the head of the femur in the acetabulum**.

5. Piriformis:

Origin: anterior surface middle part of sacrum. (It emerges from the pelvis through the greater sciatic foramen).

Insertion: upper border greater trochanter of femur.

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6. Obturator internus

Origin: inner aspects of obturator foramen and obturator membrane. (It emerges from the pelvis through the lesser sciatic foramen).

Insertion: upper border greater trochanter of femur.

7. Gemelli muscles (**superior** gemellus and **inferior** gemellus muscles):

they are a pair of 'twin' muscles lying respectively above and below obturator internus muscles; to whom they are considered accessory and additional bellies.

Origin: from the ischium, respectively above and below the lesser sciatic foramen.

Insertion: they join the tendon of the obturator internus muscle that attaches to the upper part of greater trochanter of femur.

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8. Quadratus femoris

Origin: lateral aspect ischial tuberosity.

Insertion: intertrochanteric crest and quadrante tubercle of femur.

When the posterior abdominal wall was described we mentioned the **iliopsoas muscle** (iliacus + psoas major). They originate from the lumbar portion of the vertebral column and the walls of the false pelvis conjoined narrow as descend from to pelvic cavity to an insertion into the lesser trochanter on the proximal extremity of the femur. As they pass in front the hip joint, they may produce flexion at this joint.

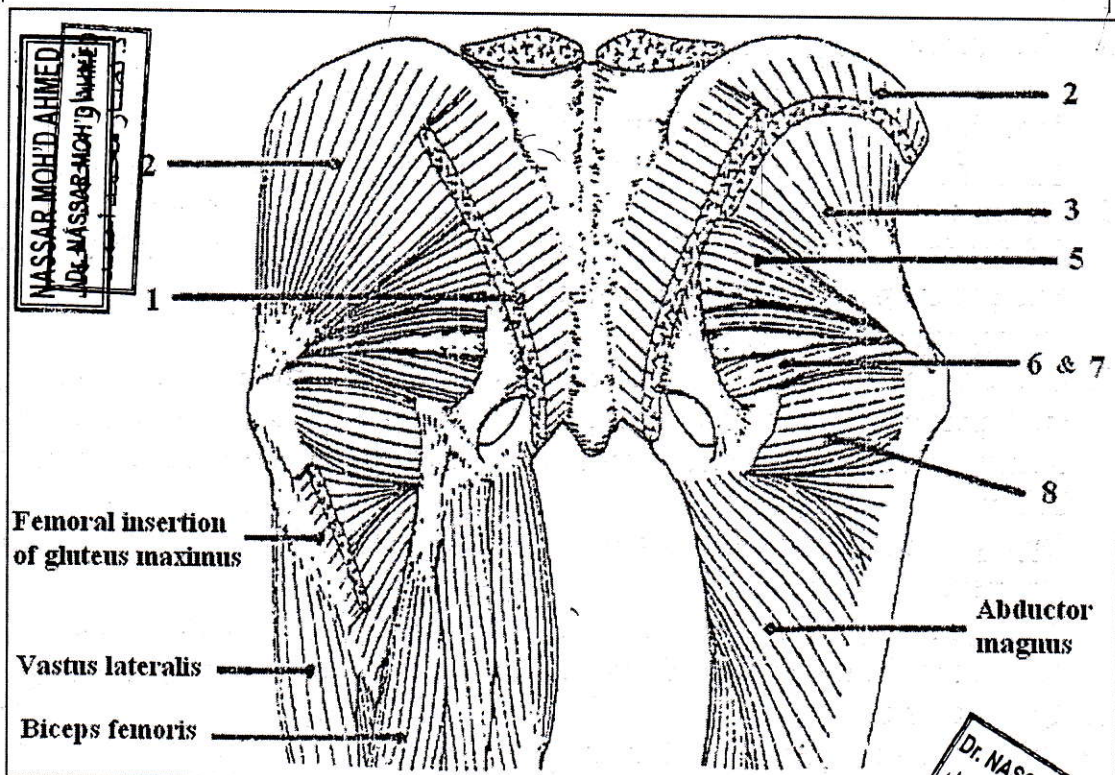
Origin: external surface of ilium between anterior and posterior gluteal lines.

Insertion: lateral aspect greater trochanter femur.

Actions: Abduction of the thigh at hip joint. By this action, the gluteus medius (and also gluteus minimus muscles) abduct or pull the pelvis on the supporting limb at each step during normal gait (walking) so, they set the center of gravity of the body over the supporting limb when the other is off from the floor.

Clinical item:

The intramuscular injection is applied into the gluteus medius muscle, near the center of the upper-lateral quadrant of buttock, to avoid injury of the sciatic nerve and superior gluteal vessels during puncture.



3. **Gluteus minimus:** deeply situated beneath gluteus medius.

Origin: gluteal surface of ilium.

Insertion: anterior surface greater trochanter of femur.

Actions: similar to those of the gluteus medius and also, medial rotation of the thigh.

4. **Tensor fascia lata:** it is situated on the lateral side of the hip, in front of the gluteus maximus and gluteus medius.

Origin: iliac crest behind anterior-superior iliac spine.

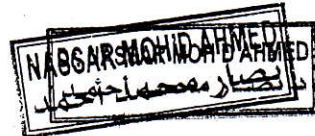
Insertion: iliotibial tract.

Actions:

II. MUSCLES OF THE THIGH

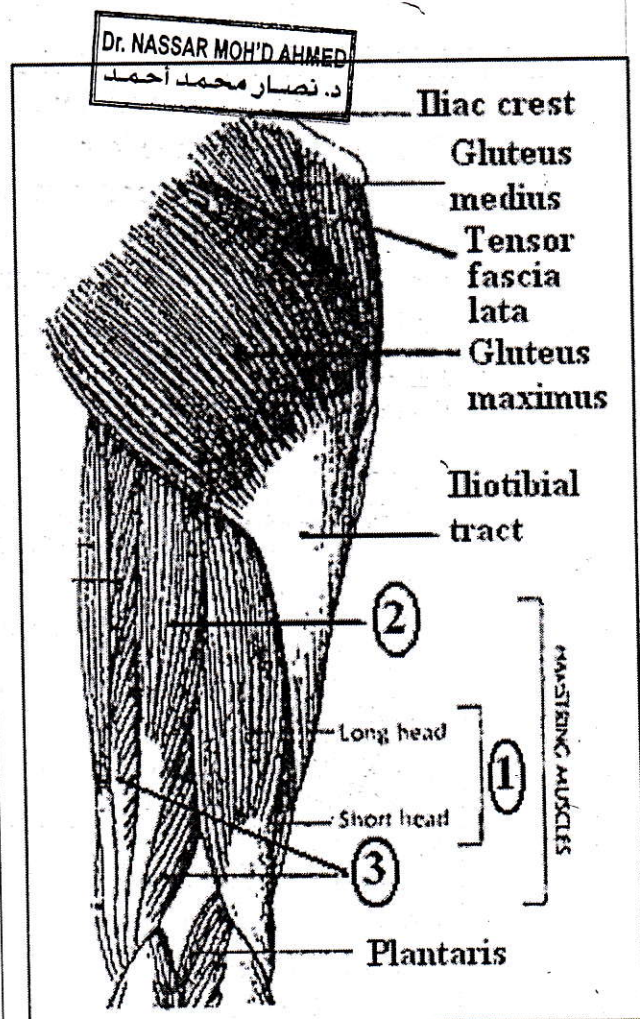
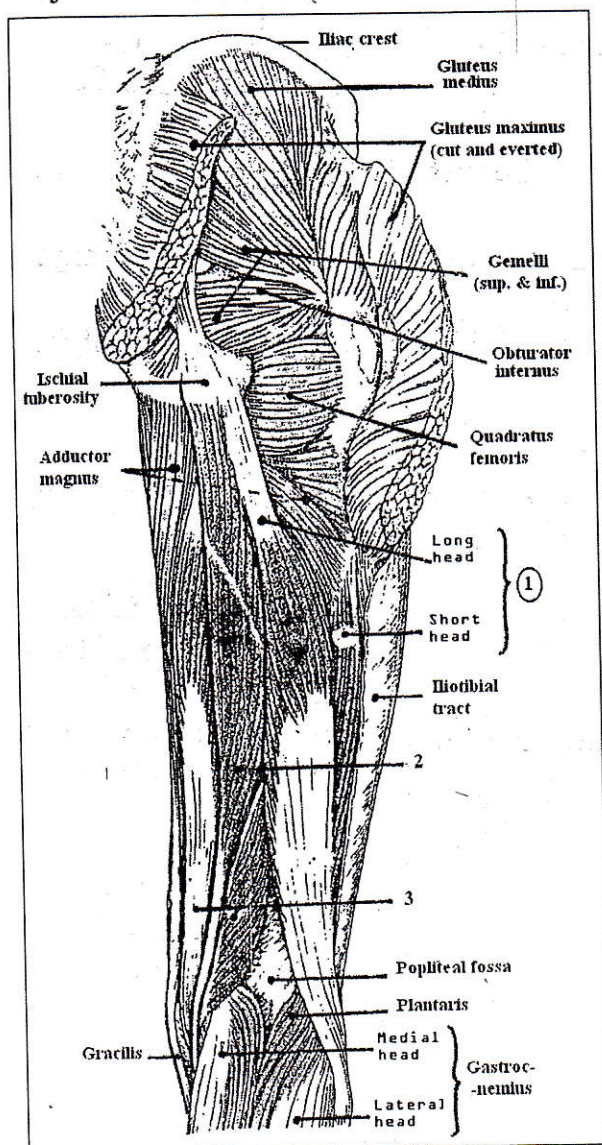
The muscles of the thigh are divided into three main groups according to their situation, action and nerve supply. On the back or posterior compartment of the thigh is the hamstring group (ham=thigh, string=rope); on the front or anterior compartment are the **cuadriceps femoris** and **sartorius** muscles; on the medial side of the thigh are the pectineus and the **adductor** muscles.

A. HAMSTRING MUSCLES (POSTERIOR GROUP)



General characteristics:

- They originate from the ischial tuberosity (**common origin**), except biceps femoris which got an additional (short) head.
- They insert either into the lateral or medial condyle of tibia, except biceps femoris which got insertion also in the head of fibula.
- They act as extensors of the thigh at hip joint and flexors of the leg at knee joint.



1. Biceps femoris

Origin: by two heads (bicipital muscles):

- Long head → ischial tuberosity
- Short head → linea aspera of femur

Insertion:

- Head of the fibula
- Lateral condyle of tibia

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2. Semitendinosus: it lies over semimembranosus.

Origin: ischial tuberosity.

Insertion: medial condyle of tibia (behind the insertion of sartorius and gracilis).

3. Semimembranosus: it lies beneath semitendinosus.

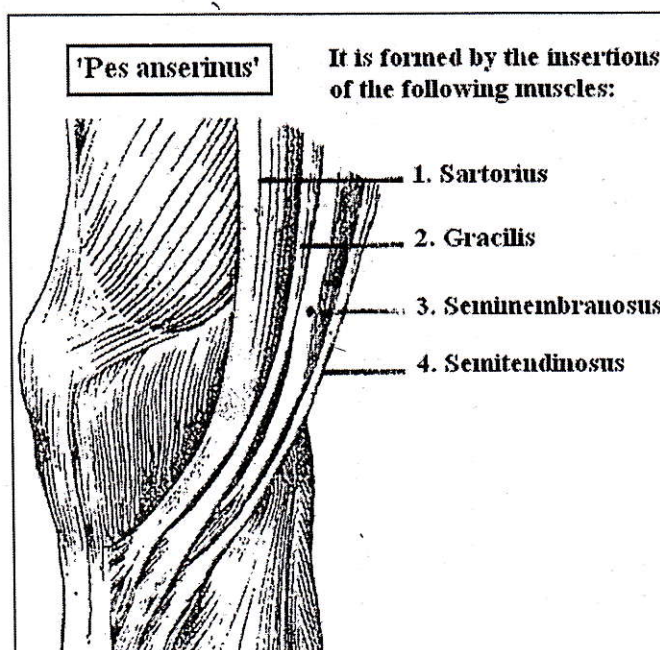
Origin: ischial tuberosity.

Insertion: medial condyle of tibia (behind the insertion of sartorius and gracilis).

ACTION OF THE HAMSTRING MUSCLES:

- Extension of thigh at hip joint.
- Flexion of leg at knee joint.
- Biceps femoris is lateral rotator of the thigh (at hip joint) and leg (at knee joint).
- Semitendinosus and semimembranosus are medial rotators of the thigh (at hip joint) and leg (at knee joint).
- All hamstring muscles limit flexion of thigh when the knee is straight (extended leg).

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'Pes anserinus'

It is the anatomical structure formed by the insertion of a group of tendons at the medial side of the knee.

pes= foot
anser= goose

B. ANTERIOR GROUP OF MUSCLES OF THE THIGH

1. **Sartorius:** long, narrow muscle which crosses the thigh obliquely downwards and medially.

Origin: anterior-superior iliac spine.

Insertion: medial condyle of tibia.

Actions:

- Flexor and lateral rotator of thigh at hip joint.
- Flexor of leg at knee joint.
- It produces the combined action of crossing-over a lower limb on the other.



2. **Quadriceps femoris:** a large muscular mass which forms the anterior bulge of thigh. It is formed by four muscles:

a) Rectus femoris

Origin: by two heads:

- Straight head → anterior-inferior iliac spine.
- Reflected head → ilium above acetabulum.

Insertion: tibial tuberosity by means of patella and patellar tendon (or ligament).

b) Vastus lateralis

Origin: lateral lip of linea aspera of femur.

Insertion: base and lateral border of patella. (An expansion called '**lateral patellar** retinaculum' inserts on the lateral condyle of tibia).



c) Vastus medialis

Origin: medial lip of linea aspera of femur.

Insertion: medial border of patella. (An expansion called '**medial patellar** retinaculum' attaches to the medial condyle of tibia).

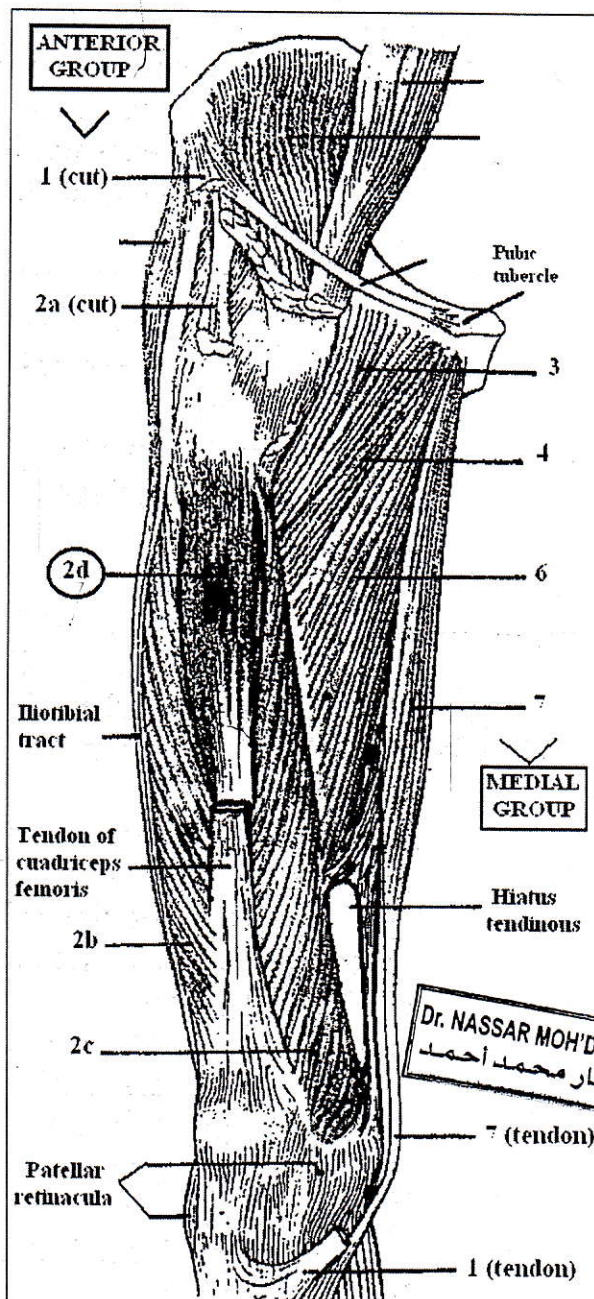
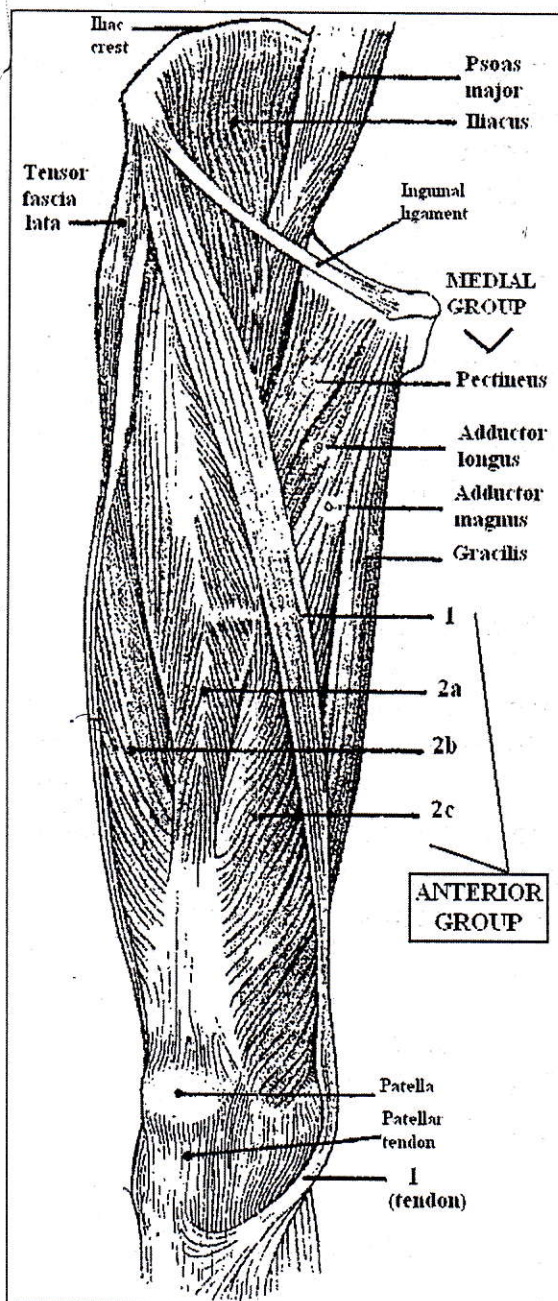
d) Vastus intermedius

Origin: anterior and lateral surfaces of upper 2/3 of shaft femur.

Insertion: its tendon joins the other tendons of rectus femoris and vastus lateralis and medialis.

ACTIONS OF QUADRICEPS FEMORIS:

- Flexor of thigh at hip joint.
- Extensor of leg at knee joint (as in the action of 'kicking').
- Raising the body from the sitting or stooped positions.
- Important in a number of actions as: walking, climbing, sitting down, and standing.
- Important in actions where the body weight falls behind the knee joint, e.g.: squatting or crouching.



C. MEDIAL GROUP OF MUSCLES OF THE THIGH

3. Pectineus muscle

Origin: superior ramus of pubis (pectin pubis).

Insertion: femur just below the lesser trochanter.

Action: flexion and adduction of thigh at hip joint.

4. Adductor longus

Origin: body of pubis below the pubis tubercle.

Insertion: linea aspera of femur.

Actions: adductor and lateral rotator of thigh at hip joint.

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5. **Adductor brevis:** partially behind adductor longus muscle.

Origin: inferior ramus pubis.

Insertion: linea aspera of femur.

Actions: adductor and lateral rotator of thigh at hip joint.

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6. **Adductor magnus:** large muscle, lying posterior to the adductor longus and adductor brevis muscles.

Origin: ischial tuberosity and ischiopubic ramus.

Insertion: linea aspera and adductor tubercle of femur. (Between the two insertions, the muscle splits in the '**hiatus tendinous**').

Actions: adductor and lateral rotator of thigh at hip joint.

NOTE: The upper part of adductor magnus muscle is often called '**adductor minimus**'.

7. **Gracilis:** long, narrow muscle, superficially at the medial side thigh.

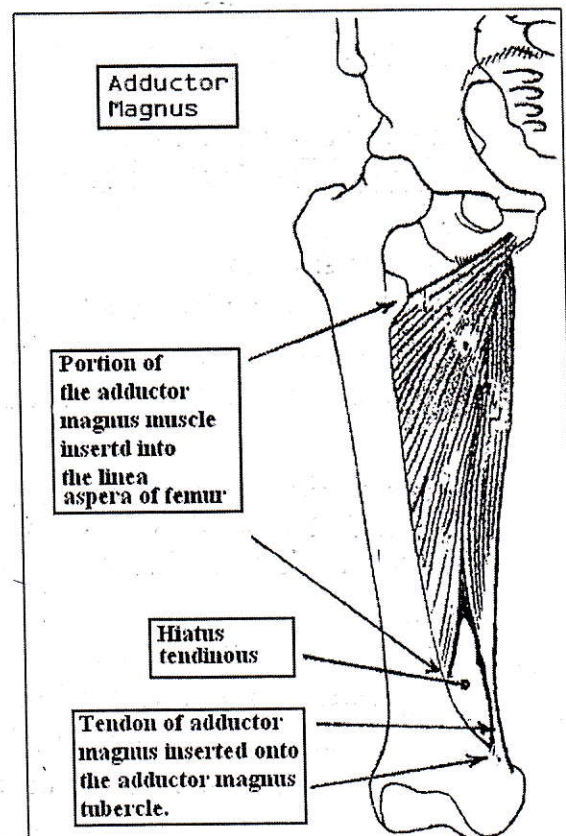
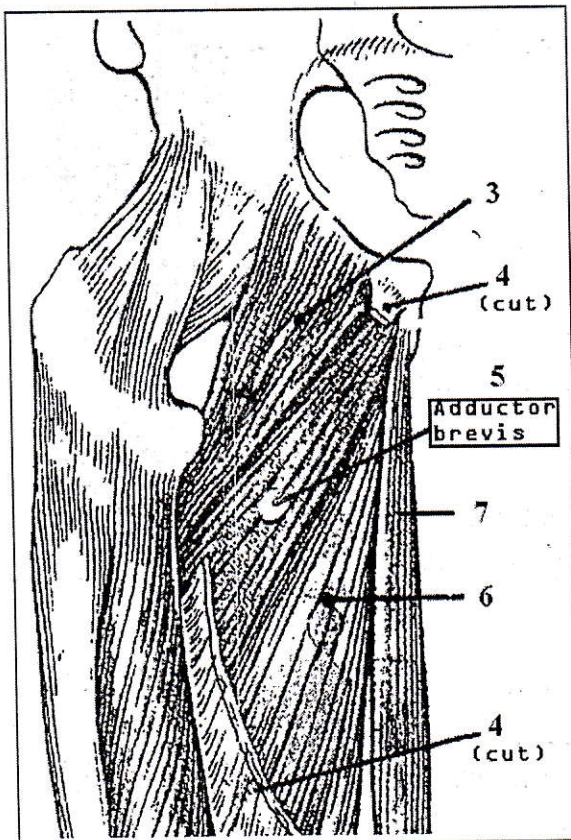
Origin: body and inferior ramus of pubis.

Insertion: medial condyle of tibia.

Actions:

- Adduction of thigh at hip joint.
- Flexion and medial rotation of leg at knee joint.

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III. MUSCLES OF THE LEG (CRURAL MUSCLES)

The muscles of the leg or crural muscles are divided into three groups, according to their situation in the fascial compartments of the leg:

- Anterior group:** placed in the anterior space between tibia, fibula and interosseous membrane. Their tendons cross the ankle joint anteriorly.
- Lateral (peroneal) group:** their tendons pass behind the lateral malleolus.
- Posterior group:** placed at the back of the calf.
 - **Superficial layer** → their tendons pass behind the knee and ankle joints.
 - **Deep layer** → their tendons pass behind the medial malleolus.

A. ANTERIOR MUSCLES OF THE LEG

COMMON ORIGIN: anterior surfaces of:

- Lateral condyle of tibia.
- Shafts of tibia and fibula.
- Interosseous membrane.

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1. Tibialis anterior

Insertion: medial cuneiform and base first metatarsal.

Actions: dorsiflexion and inversion of foot.

2. Extensor hallucis longus

Insertion: base distal phalanx of big toe.

Actions:

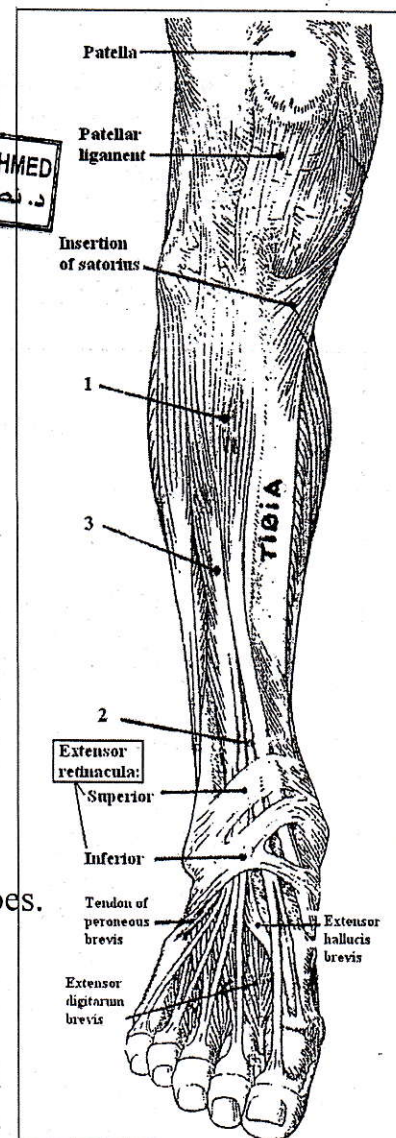
- Dorsiflexion foot.
- Extension of the big toe.
- Acting from its insertion, it is used to pull the body weight forwards during walking.

3. Extensor digitorum longus

Insertion: by four tendons into the bases of the middle and distal phalanges of the lateral four toes.

Actions:

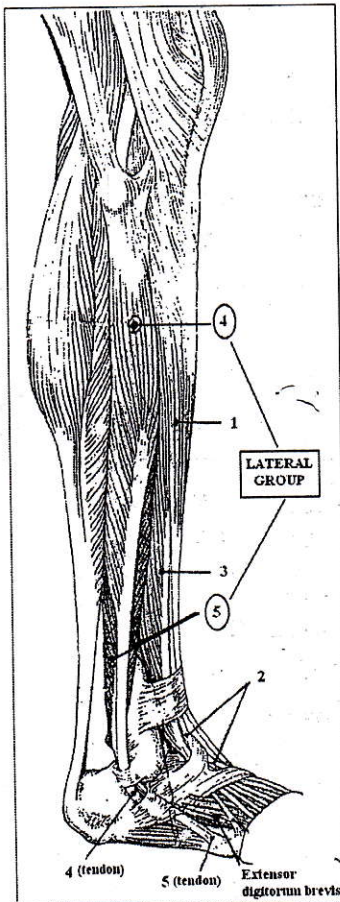
- Dorsiflexion of foot.
- Extension of the lateral four toes.
- Acting from its insertion, it is used to pull the body weight forwards during walking.



A small, often absent, **peroneus tertius muscle**, which is considered a partially separated portion of **extensor digitorum longus**, takes insertion into the dorsum of the fifth metatarsal bone.

Action: it assists in dorsiflexion and eversion of the foot.

B. LATERAL (PERONEAL) MUSCLES OF THE LEG



COMMON ORIGIN: from the shaft of the fibula.

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4. Peroneus longus

Insertion: its tendon passes behind the lateral malleolus, and crosses the lateral and inferior surfaces of the calcaneus bone to get attachment into the medial cuneiform and the first metatarsal bones (plantar surfaces).

5. Peroneus brevis

Insertion: its tendon lies parallel to that of the peroneus longus but gets attachment into the fifth metatarsal bone (plantar surfaces).

COMMON ACTIONS OF PERONEUS MUSCLES: plantar flexion and eversion of the foot.

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C. POSTERIOR MUSCLES OF THE LEG

They are divided into two layers: **superficial** and **deep**.

Superficial group of posterior muscles of the leg (muscles of the calf):

1. **Triceps surae**: large muscle of the calf, formed by three heads of origin, which join into the common '**achilles tendon**' that takes insertion into the posterior tuberosity of calcaneus bone.

- Gastrocnemius**: bicipital muscle, formed by two heads of origin which arises from the posterior aspects of the medial and lateral epicondyles of femur respectively.

- Soleus**: flat muscle, deep to Gastrocnemius.

Origin: soleal line of tibia and upper posterior part of fibula.

ACTIONS OF TRICEPS SURAE:

- It is a postural muscle that is continuously contracted during erect posture, preventing the body falling forwards (anti-gravity muscle).
- It is one of the stronger muscles of the lower limb raising the body from the sitting or stopped position.
- Soleus muscle produces plantar flexion of the foot at ankle joint.
- Gastrocnemius produces plantar flexion of the foot and flexion of the leg at knee joint.

2. Plantaris muscle: small muscle provided with a long tendon.

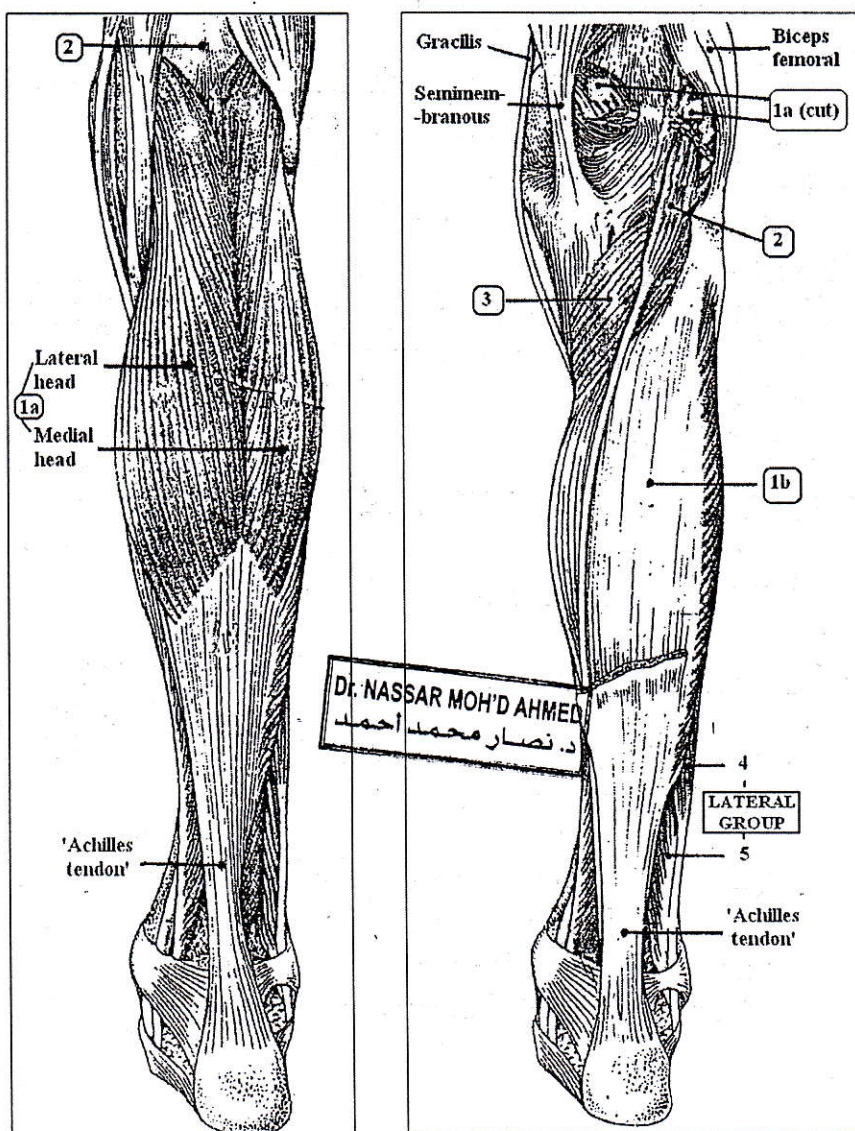
Origin: posterior surface of femur above lateral head of gastrocnemius.

Insertion: its tendon runs downwards between Gastrocnemius and soleus, related to the medial margin of 'achilles tendon' to get insertion into the posterior surface of calcaneus bone.

Actions:

- Plantar flexion of foot at ankle joint.
- Flexion of leg at knee joint.

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Deep group of posterior muscles of the leg:

3. Popliteus muscle: short, triangular muscle, which courses obliquely at the back of the knee joint from the lateral condyle of femur to the back of tibia.

Actions:

- Lateral rotator of the femur on the tibia when the foot is fixed on the ground.
- Medial rotator of the leg in the 'free' limb.
- Flexion of the leg at the knee joint.
- It is active in crouching.



The following three deep posterior muscles of the leg take COMMON ORIGIN from the posterior surfaces of the tibia, fibula and interosseous membrane. Their tendons pass behind the medial malleolus to get insertion in bones of the foot.

4. Tibialis posterior

Insertion: plantar surfaces of navicular and medial cuneiform bones.

Actions:

- Plantar flexion of foot at ankle joint.
- Inversion of foot.

5. Flexor digitorum longus

Insertion: its tendon crosses the sole of foot and splits into four tendons which attach into the distal phalanges of lateral four toes.

Actions:

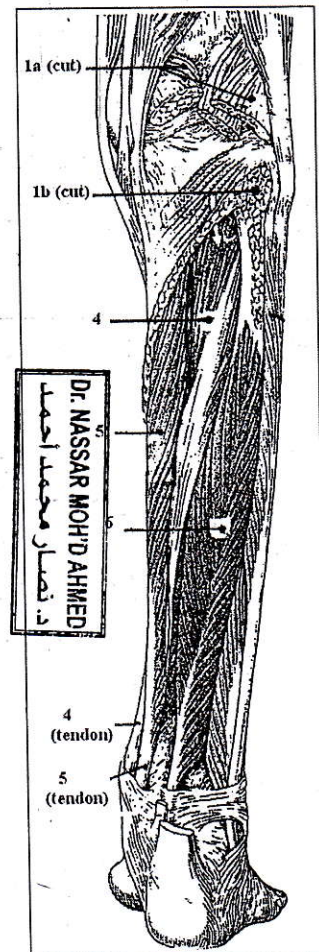
- Flexion of the lateral four toes
- Plantar flexion of foot.
- The muscle also helps in maintaining the longitudinal arches of the foot.

6. Flexor hallucis longus

Insertion: its tendon crosses the sole of the foot medially, to get insertion into the distal phalanx of the great toe.

Actions:

- Flexion of the great toe.
- Plantar flexion of foot.
- Important in final propulsive stage of walking (toe-off stage).
- It helps in maintaining the medial longitudinal arch of the foot.



IV. INTRINSIC MUSCLES OF THE FOOT

The short, intrinsic muscles of the foot are arranged in a similar fashion of those of the hand, with some special characteristics and differences. Like those of the hand, in most of them, the primary function corresponds to their own names.

A. MUSCLES ON THE DORSUM OF THE FOOT: only one muscle.

1. **Extensor digitorum brevis:** its most medial tendon is sometimes known as **extensor hallucis brevis**.

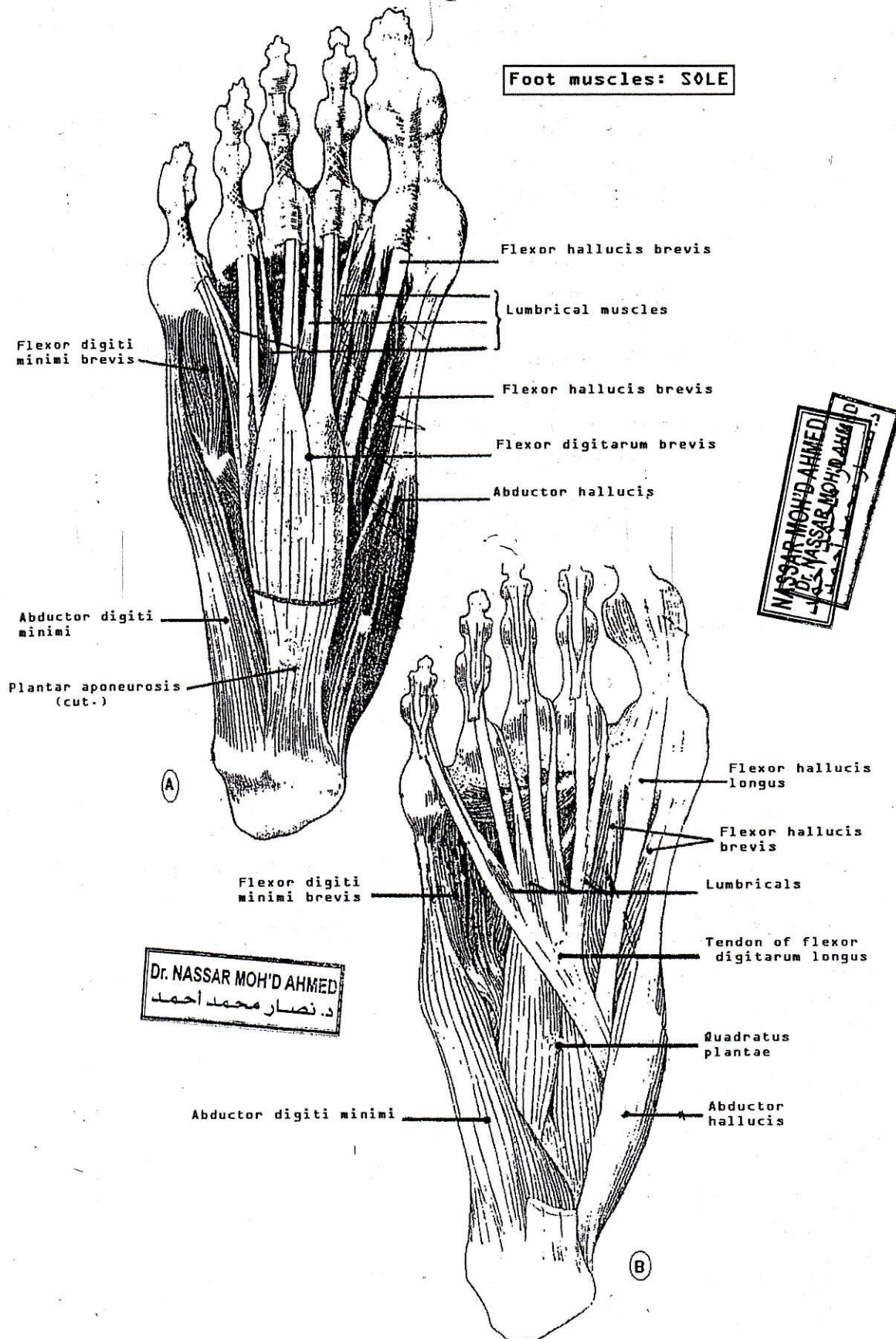
B. MUSCLES ON THE SOLE OF FOOT: usually, they are described as arranged into four layers (from the most superficial to deepest one), but they also can group similar to those of the palm of the hand into three groups:

- **Medial group** (related to the big toe)
- **Lateral group** (related to little toe)
- **Middle or central group.**

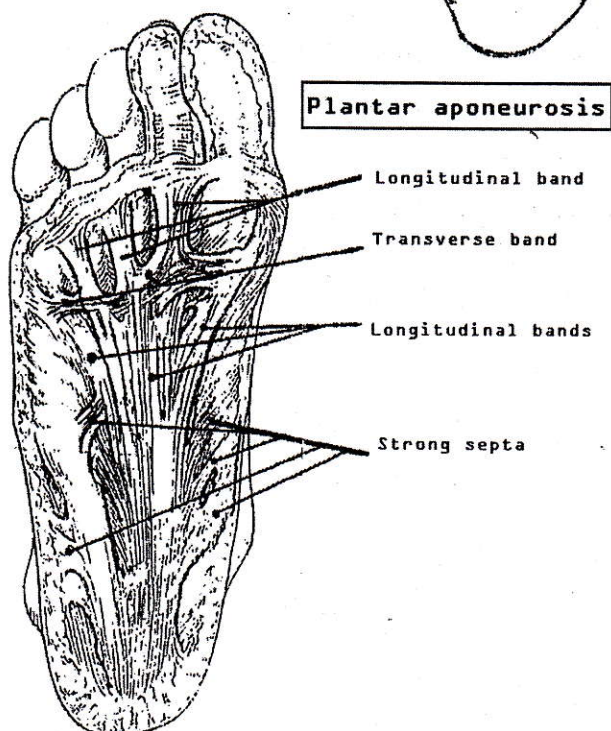
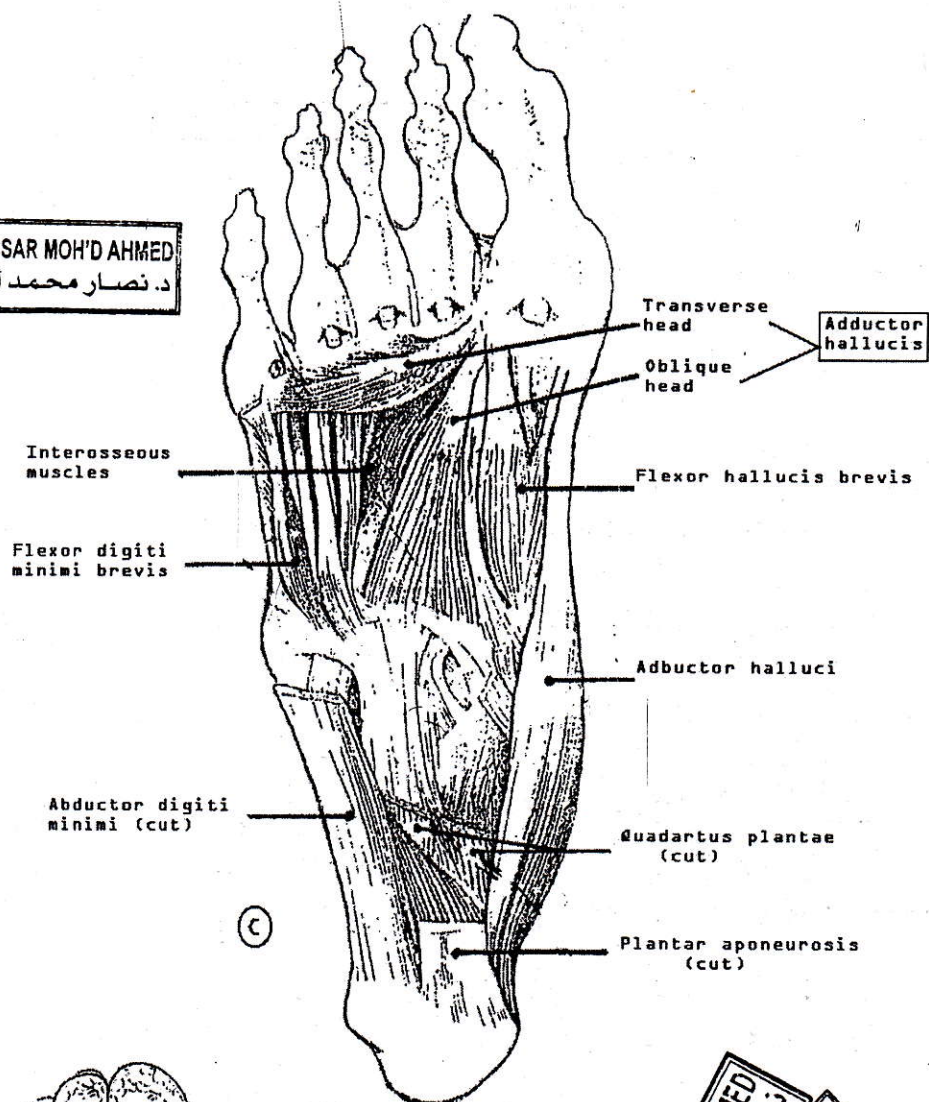
1 st layer	2 nd layer	3 rd layer	4 th layer
Abductor hallucis	Quadratus plantae	Flexor hallucis brevis	Interossi dorsal (4)
Flexor digitorum brevis	Lumbricalis	Adductor hallucis <ul style="list-style-type: none"> • Oblique head • Transverse head 	Plantar
Abductor digiti minimi		Flexor digiti minimi brevis	

→ Whereas the chief importance of the intrinsic muscles of the hand is their control of the fine movements of the individual fingers, **the most important function of the intrinsic muscles of the sole of the foot** (despite of their primary actions), **is their massed action in the movements of walking, and to maintain the arches of the foot.** For this last function, the strong plantar aponeurosis plays an important part.

Foot muscles: SOLE



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ATTACHMENT: SOME IMPORTANT ELEMENTS ABOUT REGIONAL ANATOMY OF THE LOWER LIMB

The femoral triangle: it occupies the upper third of the front of the thigh with the apex downwards and shows the following boundaries:

(→ See picture in page 9)

- The base → is the inguinal ligament.
- Laterally → medial border of sartorius.
- Medially → medial border of adductor longus.
- The floor → formed by iliopsoas and pectineus muscles.

(The lateral and medial borders meet at the apex)

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Contents: mainly the **femoral sheath** containing the femoral vessels, nerve and lymphatics. The **femoral canal** lies immediately lateral to the lacunar ligament.

Clinical point: Abdominal viscera, usually intestine, may herniate through the canal into the front of the thigh forming a **femoral hernia**, which is more common in female.

The adductor canal is an aponeurotic tunnel in the middle third of the thigh - distally to the femoral triangle- formed by sartorius and vastus medialis, and posteriorly by adductor longus and magnus muscles. Through this canal run the femoral vessels (artery & vein) and also some nerves.

The popliteal fossa: it is a rhomboid or diamond-shaped depression at the back of the knee joint. Their boundaries are:

(→ See picture in page 13)

- Upper sides → the diverging hamstring muscles.
- Lower sides → the converging medial and lateral heads of gastrocnemius.
- The floor → the popliteus muscle, the articular capsule of the knee joint and the popliteal surface of the femur.

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Contents: mainly the popliteal vessels and lymph nodes and the terminal branches of sciatic nerve.

Clinical point: this region is suitable for exploring the arterial pulse and for palpating the lymph nodes in some necessary cases.

GUIDE FOR PRACTICAL CLASS # 10

Theme: MUSCLES OF THE LOWER LIMB

Summary: 1. Description of the muscles groups.

- Gluteal region.
- Thigh muscles.
- Leg muscles.
- Foot muscles as a whole.

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2. Surface anatomy of these muscle groups.

Objectives:

1. To classify the muscle groups of the lower limb, explaining its general characteristics and indicating them in the dissected cadaver or anatomical model.
2. To identify in the anatomical pieces or model the main muscles of the lower limb and characterizing their actions.
3. To identify on the skin surface of the lower limb, the most distinct relevant muscles.

Methodological orientations (TASKS)

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1. Identify in the dissected cadaver or anatomical model **the muscles of the gluteal region** and describe the general and particular characteristics of each one of these muscles.
 - In order to study the general characteristics, follow the orientations about study of muscles.
 - Make an illustrated table or summary.
 - In order to analyze the muscular action of each muscle, it is important to observe the direction of the muscular fibers, the extension and the joint at which the muscle act.
 - Do the movement expected and explain what muscle acts to produce each type of movement.
 - Utilize the Atlas, fig 327 to 340.
2. Identify in the anatomical pieces or model **the muscles of the thigh region** and describe the general and particular characteristics of each one of these muscles.
 - Make an illustrated table or summary.

- In order to analyze the muscular action of each muscle, it is important to observe the direction of the muscular fibers, the extension and the joint at which the muscle act.
 - Do the movement at the hip and the knee joint and point out what muscles act in each movement.
 - Utilize the Atlas, figures 332 to 340.
3. Show in the dissected cadaver the **muscle groups of the leg and foot** and describe its general characteristics.
- Utilize the Atlas, figures 341 to 365.
 - Make an illustrated table or a summary.
 - In order to analyze the action of the muscle groups it is necessary to observe the situation and extension of each muscle. Some of them are polyarticular.
 - Do yourself the movements of the foot and toes and mention what group of muscles provides these movements.
4. **Surface anatomy:** identify the relief muscles in relation to the kin surface of inferior limb.
- In the gluteal region palpate the contracted gluteus maximus.
 - Point out the area of the intramuscular injection in the gluteal region (supero-lateral quadrant).
 - In the anterior aspect of the thigh, observe the sartorius and cuadriceps femoris muscles, especially when they contracted. Palpate the **femoral triangle**.
 - Indicate the situation of the patellar ligament.
 - In the posterior aspect of the leg observe the muscular folds formed by the gastrocnemius muscles and palpate the **popliteal fossa**.

Bibliography:

- Cunnigham's textbook of Anatomy. 12th edition. Pages 374 to 404.
- Sobotta/figge. Atlas of Human Anatomy. Vol 1. Pages 226 to 259.
- You may use the Learning guide to Practical Anatomy I' (booklet). Pages 43, 48 to 52.

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